# IV AQUATIC AND RIPARIAN ECOSYSTEM

## IV.1 WATER QUALITY

***What are the historic and current processes delivering sediment to tributary streams and along the North Fork Chetco River?***

There has always been a natural source component of sediment delivery to stream channels. Landsliding, debris avalanches and debris torrents, streamside shallow rapid movements, surface erosion after historical fires, stream channel sediment adjustments and flooding have contributed soil material.

The principal current processes delivering sediment to tributary streams and along the main river in the analysis area include shallow rapid hillslope failures adjacent to channels (84%), debris avalanches and flows resulting in debris torrents (13%) and large persistent deep-seated slides (3%) (refer to Section III.5-Erosion Processes).

***What is the response of the analysis area to storm events in regard to producing sediment?***

The higher stream discharges that occur several times a winter and infrequent extreme events carry the majority of the sediment load. Flooding can cause landsliding and delivery to streams, and extend the stream network to capture unconsolidated colluvium in ephemeral channels and hollows. High flows which carry the greatest sediment loads occur less than 5% of the time (Figure III-22).

Turbidity measurements were taken during the 10/94 through 11/95 time period at five sites in the analysis area (Figure IV-1). Turbidity is a measure of the cloudiness of water, and can be correlated with a suspended sediment load. A source search turbidity study was completed over a two-year period. Pre-storm samples were collected and compared with several storm periods at one location in selected drainages. Results show that during non-storm times, turbidities were low at all sites (example; 7/13/95, range of 0.9-2.2 NTU). During storms, turbidities increased 11 to 67-fold on January 10, 1995, and 180-fold on November 8, 1995. These increases are correlated with a 24-hour precipitation of 2.0" or more (Figure IV-2). Of the drainages surveyed, Cassidy, Bosley and Middle-Upper Chetco had the highest levels of turbidity. This may be due to the high clay contents within the drainages of the Cassidy Creek and the Upper North Fork Chetco. Somewhat lower turbidities were noted in Bravo Creek during storms.

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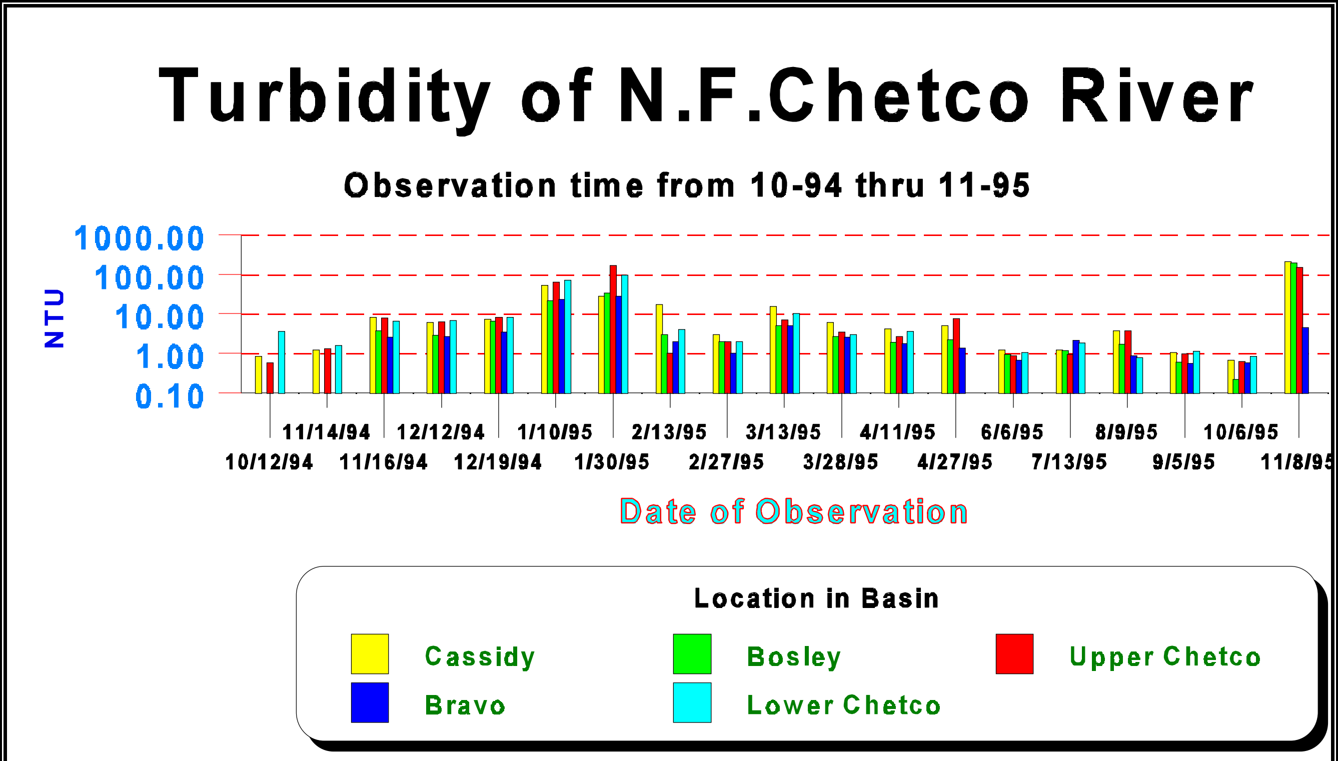
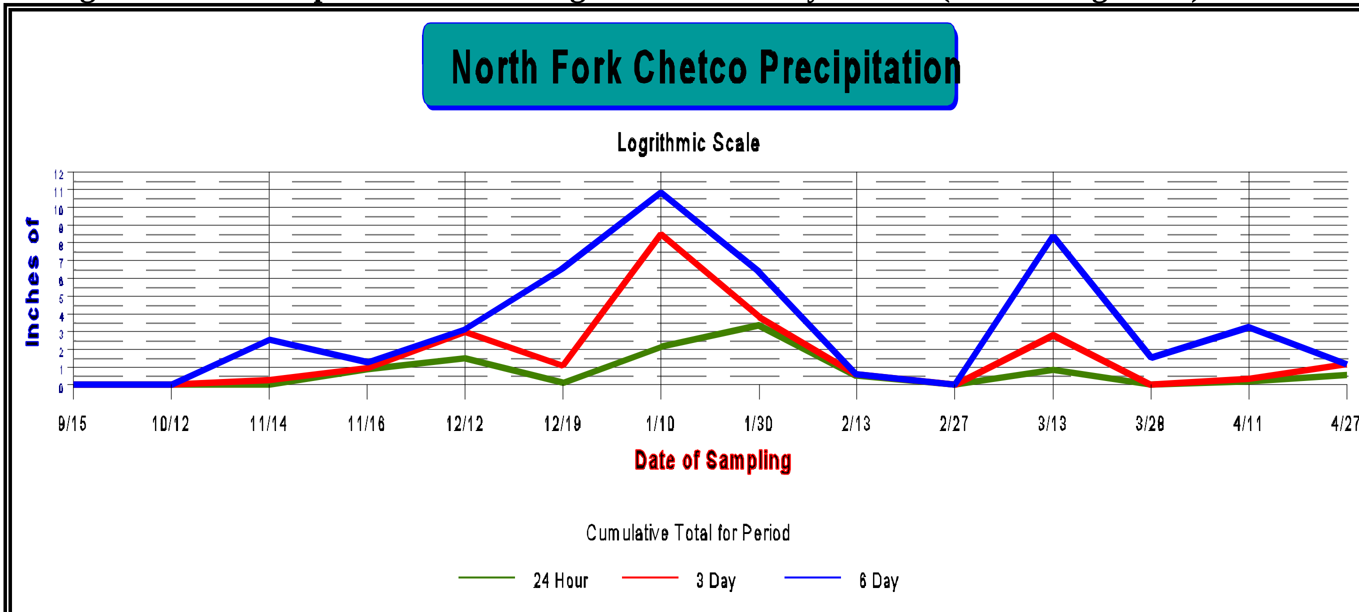
Figure IV-1 Sediment Monitoring within the Analysis Area (10/94 through 11/95).




| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cass | 0.83 | 1.20 | 8.00 | 6.00 | 7.30 | 51.0 | 28.0 | 17.0 | 3.00 | 15.0 | 6.10 | 4.08 | 5.07 | 1.23 | 1.23 | 3.74 | 1.04 | 0.68 | 206. |
| Bosl | | | 3.70 | 2.90 | 6.40 | 21.1 | 34.0 | 3.00 | 2.00 | 5.00 | 2.70 | 1.88 | 2.20 | 0.94 | 1.15 | 1.71 | 0.59 | 0.22 | 194. |
| Uppe | 0.58 | 1.30 | 7.70 | 6.20 | 8.20 | 61.8 | 166. | 1.00 | 2.00 | 7.00 | 3.40 | 2.64 | 7.56 | 0.87 | 0.92 | 3.77 | 0.97 | 0.62 | 148. |
| Brav | | | 2.60 | 2.70 | 3.40 | 23.1 | 28.2 | 2.00 | 1.00 | 5.00 | 2.60 | 1.77 | 1.36 | 0.67 | 2.15 | 0.87 | 0.56 | 0.58 | 4.45 |
| Lowe | 3.60 | 1.60 | 6.50 | 6.80 | 8.00 | 70.4 | 95.1 | 4.00 | 2.00 | 10.0 | 3.00 | 3.64 | | 1.05 | 1.81 | 0.79 | 1.11 | 0.84 | |

Figure IV-2 Precipitation Monitoring within the Analysis Area (9/94 through 4/95).




| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 Hour | 0 | 0 | 0 | 0.86 | 1.48 | 0.12 | 2.13 | 3.38 | 0.51 | 0 | 0.85 | 0 | 0.21 | 0.57 |
| 3 Day | 0 | 0 | 0.26 | 0.94 | 2.99 | 1.1 | 8.5 | 3.82 | 0.59 | 0.01 | 2.85 | 0 | 0.36 | 1.19 |
| 6 Day | 0 | 0 | 2.54 | 1.26 | 3.16 | 6.57 | 10.83 | 6.36 | 0.59 | 0.01 | 8.36 | 1.52 | 3.26 | 1.19 |

***How quickly can the analysis area recover from the effects of sedimentation after a major storm event?***

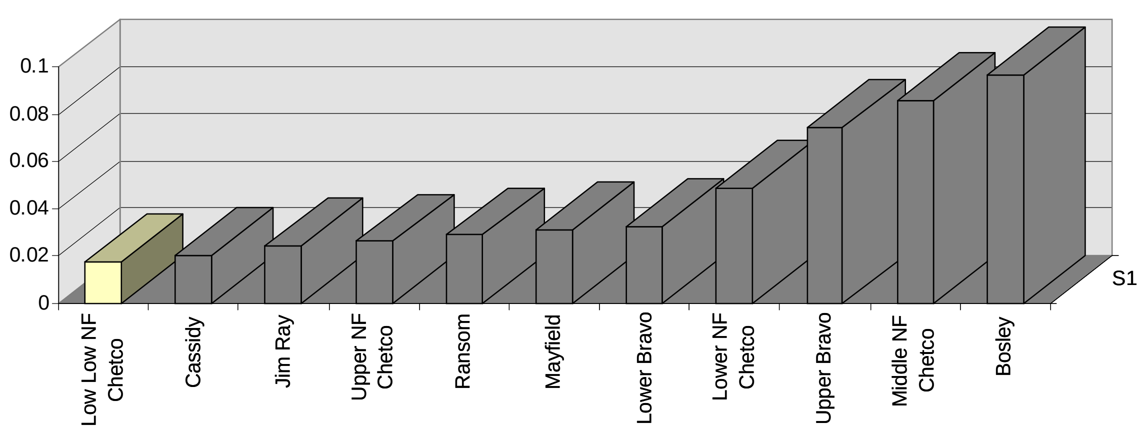
Generally the water is very clear and clouds (NTU>10) only during major storms.  Visual observation of the recovery of the stream to pre-turbid conditions happens fairly quickly (2-5 days) on the recession leg of the hydrograph as the storm passes.

***Where are the source areas contributing to sedimentation in streams. Which streams are vulnerable to sediment transfer and deposition.  Is sediment suspected to interfere with beneficial uses?***

Source areas include delivery from streamside hillslope failures, bankcutting, landslides and delivery to channels from compacted areas including roads.  (Refer to Section III.5-Erosion Processes).

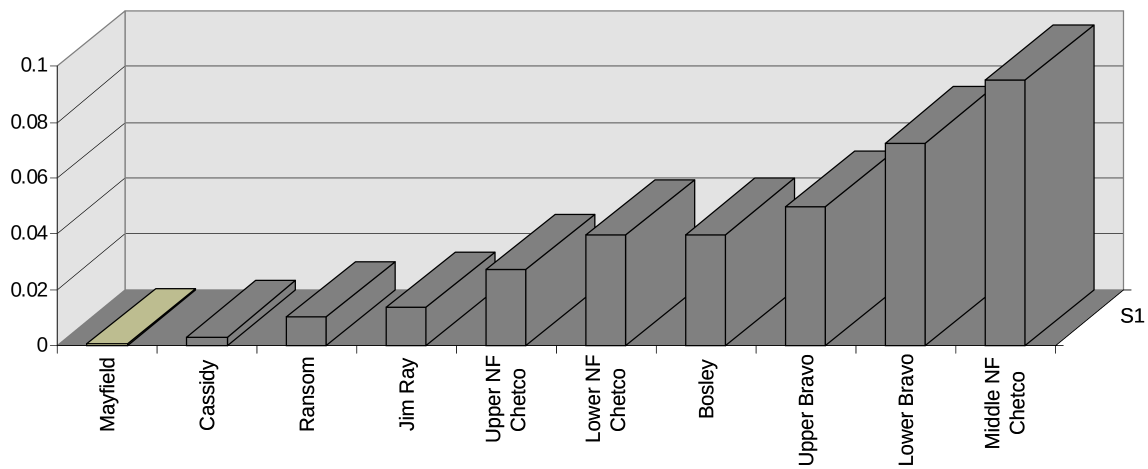
The likelihood of sediment routing downstream (transfer) was determined for the analysis area using a model by Geier et al. (1995).  The sediment transfer hazard represents the transport efficiency of the streams, the stream flow, and fluvial energy of the drainage.  The bankfull flow is closely associated with the 2-year flood event.  Figure IV-3 shows a comparative sediment transfer hazard for the eleven hydrologic units in analysis area.  Bosley, Middle North Fork, and Upper Bravo have the highest efficiency and highest potential of transferring sediment downstream, introduced from landslides or other sources.  Bosley and Bravo Creek are higher elevation drainages, can collect snow and therefore have higher runoff potentials.  Middle North Fork drainage has a higher drainage density and moderate relief, and is able to collect and route sediment through many of the reaches.  The remaining drainages have some combination of lower drainage densities, lower total relief or lower bankfull discharge, compared with the remainder of the analysis area.

**Figure IV-3    Streams with High Transport Efficiency**



Sediment depositional hazard was estimated for the analysis area using a model by Geier et al. (1995) (Figure IV-4). The index includes the proportion of low gradient streams (<2%) in a hydrological unit multiplied by a discharge coefficient. Low gradient streams in Bosley, Middle North Fork Coquille and Upper Bravo drainages have the highest depositional hazard. Mayfield, Cassidy, Ransom and Jim Ray hydrological units include the lowest risk for sediment deposition in low gradient streams, due principally to the steep nature of the drainages.

**Figure IV-4 Streams with Sediment Depositional Hazard.**




Fine sediments (<2.0 mm, including clay/silt and sands) are moved quickly downstream during storms and do not tend to accumulate in appreciable amounts in the drainages, even in low gradient reaches. Data collected at sites within the analysis area suggest that appreciable fine sediment volumes do not remain in the channel and are exported during the frequent flows. Pebble count sampling was completed in low gradient (generally <2%) depositional reaches in all 11 hydrological units (Appendix C-2). Results show that generally less than 15% of all surface substrate material fit the fine sediment category. In addition, visual observation of many stream channels does not show accumulations of fine materials.

Results of the pebble count sampling show that generally 70% or more of all surface substrate material fit the coarse sediment category. Deposition by coarse sediments (>2.0 mm, including the gravel and cobble sizes) in stream channels can be temporary or chronic. Persistent or overwhelming deposition and an available sediment source can lead to channel aggradation in low gradient reaches. Aggradation of coarse sediments raise the stream bed base level. Loss of late summer streamflow in alluvial reaches can occur, as minimal flow becomes groundwater (refer to Section III-6 Hydrologic Processes - low flow discussion). These and other factors can lower the habitat quality of stream reaches by increasing channel width and decreasing pool area and depth.

Slides occurring during big storms may temporarily dam the channel as large volumes of sediment and organic material move downstream, such as the large slide that entered Bosley Creek about 1992. Elsewhere, shallow rapid movements inside the inner gorge have partially to totally blocked channels and were particularly frequent during the 1940-1970 period. There are terraces in some channels, with hardwood colonizing on the surfaces that appear to be relics of the 1964 flood. Coarse sediment is temporarily stored in the channels from these pulses, but does not remain for long time periods due to relatively high stream gradients.

The routing of sediment has been slightly altered by the addition of stream crossing culverts to the landscape. Not all culverts are restricting the passage of bedload downstream, but a notable number have backed up larger sized materials. These culverts area characterized by level gradients or slightly less than level (.5%), floatable debris has partially blocked the culvert, or where the inlets have been deformed. Large and deep fills generally are associated with stream crossing culverts in the analysis area. Culvert outlets can produce high velocities of water from "shotgunned" pipes. This extra energy fills further remove the armor layer trying to establish itself in the channel and may undermine road fills.

Coarse sediment may be interfering with beneficial uses including fish and aquatic life for short periods (1-10 years) as the material is moved downstream, but probably not on a sustained basis.

***Are there, and if so where, are roads that are contributing sediment to streams? What is the future monitoring and management of the road system to reduce sedimentation and other potential problems?***

Roads alter the hydrology of drainage in several ways: increased surface runoff from compacted roadways, interception of subsurface water by cut slopes, and more rapid routing of water to stream channels via road ditches and culverts. In essence the ditch system may operate much like an extended stream network. All of these effects tend to result in increases of annual yields and peak flows.

Within the analysis area, approximately 82% of the road system is natural surfaced (25 miles of BLM and 94 miles of private road). The remaining system is predominately gravel, including the main access roads within the analysis area. The county roads which are along the area boundary are paved. Roads that are inadequately maintained and lack a vegetative cover, resulting in gullying, are sources of sediment.

Delivery of fine sediments from natural road surfaces occurs within the analysis area. Not all roads deliver sediment and it does not appear to be an active process unless there is over saturation of the road surface by intense rainfall, usually 2 inches/hr or more (BLM, visual observations over 8 years). When the permeability rate is exceeded along roadways, splash, rill, and gully erosion are frequently noted. Because ditch relief culverts are inadequately spaced, runoff collects for large distances prior to finding its way off the road prism. It is this excessive collection of water and fine sediment and subsequent diversion back into the main roadway that is a problem in the analysis area. This inadequate design for road drainage impacts the stream network where the collected water reaches a stream. Fine sediments and extra volumes of water may be added to streams and could advance runoff in a storm. However, many of the runoff ditches empty on to vegetated surfaces and filtering of the water takes place. Newly constructed or maintained road surfaces contribute fine sediment until vegetation becomes established, or until erosion removes fines from the surface leaving rock as an armor. The inherent high rock component of the parent materials aids in this type of recovery. Erosion effects are highly variable depending on concentration of water. Once gullying starts it is slow to recover in the analysis area.

Roads above 2000 feet in the upper Cassidy, Bravo and Bosley drainages have significant rilling and gullying. There is also rilling and gullying occurring on old skid roads and fire trails in these drainages. Intense rain and occasional snowmelt at higher elevations, coupled with silt/clay erodible soils on the ridgetops, are factors leading to rill and gully erosion.

The TMO process identified several roads contributing sediment and recommended varying actions (from decommissioning to improvement). This interdisciplinary process by specialists is used to set management and maintenance levels. Listing of individual roads is located in Appendix F-2.

***Are there reaches where summer stream water temperatures are above State ODEQ Water Quality Standards? Which stream segments have frequent accedences?***

Streams in southwestern Oregon are known for their relatively high summertime temperatures, but it is not clear whether this is related to a latitudinal gradient, high solar radiation loads, low flows, or other related factors (Beschta et al. 1987). Monitoring of stream temperatures during the drought of 1992 did not show a strong correlation between maximum stream temperature and elevation (Oregon Forest Industries Council 1993). It is known that direct daytime heating of stream water (from lack of shade) during critical summer months when the incoming solar radiation load is high, is a principal factor to explain increased temperatures. It is also known that temperatures increase in a downstream direction.

Elevated water temperatures have been noted throughout North Fork Chetco, although actual recorded data is quite limited. High temperatures are attributed to loss of riparian vegetation providing shade, wide and unshaded lower stream areas, and low flows. Lower North Fork Chetco and Bravo Creek were was listed on ODEQ's 303(d) list of water quality limited streams. The seven-day rolling average maximum temperature exceeded the basin criteria of 64 °F for several periods during the summer. Temperature monitoring information is shown in Table IV-1 (station locations are shown in Appendix C-2).

**Table IV-1 BLM 1995 Temperature Monitoring Summary for North Fork Chetco [1]**

| Streams | Seasonal Max. | Date | Seasonal Min. | Date | Delta T | Date | 7 Day Max. | 7 Day Min. | 7 Day Delta T | Days >64° | Seasonal Max. 64° |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NFC near mouth | 77.6 | 8/03/95 | 58.1 | 8/26/95 | 15.5 | 8/03/95 | 75.7 | 63.1 | 12.6 | 57 | 13.6 |
| NFC near Mayfield Crk. | 71.7 | 8/04/95 | 49.4 | 6/20/95 | 11.2 | 8/19/95 | 70.1 | 60.8 | 9.3 | 61 | 7.7 |
| Bravo Crk in Sec. 2 | 74.4 | 8/04/95 | 47.8 | 8/20/95 | 13.4 | 7/31/95 | 72.2 | 60.5 | 11.7 | 31 | 10.4 |
| NFC at bridge above gorge | 65.9 | 8/04/95 | 54.2 | 7/3/95 8/26/95 | 5.7 | 8/03/95 | 64.5 | 59.9 | 4.7 | 5 | 1.9 |
| Bosley Creek | 63.5 | 8/04/95 | 48.4 | 6/20/95 | 4.2 | 6/24/95 | 62.3 | 59.3 | 3.0 | 0 | 0 |

[1] Definitions:

Delta T - Highest value of daily difference between max. and min. for the season
7 Day Max. - Average value of daily maximums for the highest seven consecutive 7 days
7 Day Min. - Average value of daily minimums for the same 7 days
7 Day Delta T - Average of the daily difference between max. and min. for the same 7 days
Seasonal Max. 64° - Number of degrees seasonal max. is above 64° F

A 7-day $\Delta$T >5 °F indicates that mid-afternoon stream temperature elevates daily in response to increased direct solar radiation. This is observed in stream reaches where riparian vegetation canopy has been removed, or in very wide stream channels that do not receive topographic or riparian shading.

Stream temperatures in the analysis area generally increase in a downstream direction coinciding with less canopy cover above the stream channel. The middle section of Bravo Creek and the lower mainstem North Fork Chetco exhibited the warmest daily water temperatures and the greatest diurnal fluctuations in stream temperature.

***Were historic stream water temperatures, particularly in the summer, lower than the present? What have been the factors of change? What is the trend?***

In 1940, most of the riparian zones contained contiguous cover of conifer and hardwood trees shading the stream. However, some had been fire-disturbed with some overstory and understory vegetation removed (refer to Section IV.4-Riparian Habitat). Low gradient, depositional stream channels may historically have had different dimensions than today; streams were likely narrower and deeper, and connected to a floodplain. If so, water moving downstream would have received less solar heating, and may have exchanged with and replaced bank-stored water in lowland alluvial reaches. This effect would act as a heat pump, removing heat from the stream in a down valley direction (Beschta 1996).

Historic and recent data suggest that *one* baseline or "reference condition" for seasonal maximum stream temperature is less than 64 °F. This was based on mainstem and tributary temperature data taken mid-day during summer and would apply only to unharvested segments or recovered fire-disturbance segments that contain >50% canopy closure. A higher reference condition is possible in segments that are not recovered from more severe stand-replacement fires.

Data (spot-check) taken from Bravo Creek in August, 1972 illustrates the baseline or "reference condition" for stream temperature. Examination of historical air photographs of the upper Bravo Creek drainage (CB GRIZ - 1969 and 1970; and C.S.B 1940) showed a fire-disturbance vegetative landscape (in un-harvested areas), with large conifer trees concentrated in riparian areas, and hardwood species dominating the riparian understory and upland areas. The 1940 and 1970 aerial photos showed that these large trees and associated vegetation provided 50-75% canopy closure over the stream channel. By 1970, timber harvest in Bravo Creek was concentrated in the downstream sections of the drainage (Sections 2, 3, and 9, T.40 S.,R.13 W.). Photos showed that where large conifers and other vegetation were harvested from the riparian area, the stream channel was visible under a 0-25% canopy closure. In the harvested area, mid-afternoon water temperatures in Bravo Creek reached 76 °F., while water temperatures in unharvested areas upstream were 64 °F. Some of the increase could be due to increasing channel width downstream, but this factor is not likely to account for the 12 °F increase in a distance of two miles.

**Table IV-2 Comparison of Historical and Recent Summer Stream Temperatures.** Data was obtained from a small set of point observations during a habitat survey in 1972-82, and from continuously recording water temperature monitors in 1994 and 1995.

| | **Historical Point Observation** | | | **Continuously Recording Thermographs Range in Daily Maximum Temperature** | | |
|---|---|---|---|---|---|---|
| **Location** | Date | Time | Water Temp. | 1994 | 1995 | Comparative Period of Record |
| NFC near Mayfield Creek | 6-18-70 | 10:15 AM | 60 | 56-60 | 52-56 | third week in June |
| NFC near Mayfield Creek | 9-15-82 | 1:15 PM | 64 | 57-67 | 60-68 | first week in Sept. |
| Bravo Cr. in Sec. 2 (site 2) | 8-8-72 | 4:15 PM | 67 | 68-71 | 62-75 | first 2 weeks in Aug. |
| NFC at bridge above gorge | 10-5-82 | 10:00 AM | 54 | - | 52-59 | first week in Oct. |
| Bosley Creek (site 3) | 6-18-70 | 12:10 PM | 55 | 58-62 | 50-55 | third week in June |

Available data suggests that there probably have not been significant changes in stream temperature patterns since the early 1970's. The aerial photography record showed that by 1970, a significant portion of the riparian canopy had already been clearcut harvested.

***Are there processes affecting dissolved oxygen levels within the analysis area? If so, identify the processes and what streams are affected? What were historic stream oxygen levels?***

The amount of oxygen dissolved in water can affect water quality and aquatic habitat. The solubility of oxygen in water is inversely proportional to temperature and directly proportional to atmospheric pressure. Most tributary streams are at saturation for their given elevation and temperature, because of stream tumbling and aeration, except for low stream flow periods. Dissolved oxygen levels may be reduced due to microbial decomposition of organic matter, known as biochemical oxygen demand. During late summer/fall, when flows are low, dissolved oxygen may fall below saturation due to the addition and decomposition of leaf litter from riparian forests (Taylor and Adams 1986).

Although no measurements have been recorded, dissolved oxygen in lower North Fork Chetco in the gentle gradient stream reaches probably declines to low levels during late summer low flow. Decomposition of algae in these valley bottom stream types may be depressing oxygen levels.

Although dissolved oxygen levels fluctuate with the seasons, it is thought that historic levels were seldom below saturation. Factors including decreased stream temperatures, lack of algae, less hardwood detritus, and narrower and deeper streams storing larger volumes of in-channel water, are thought to be characteristics that prevented significant oxygen reductions in stream water.

Little information is available to know if oxygen depletion is a currently a problem in the analysis area. The Non Point Source Assessment (ODEQ 1988) indicates dissolved oxygen is a moderate problem for the North Fork Chetco.

***Are there processes contributing to fecal coliform levels within the analysis area? If so, identify the processes and what streams are affected? What were historic conditions?***

The City of Brooking's has recently been spraying sewage sludge in upland areas on private lands. These sites are well away from stream channels and is not expected to be contributing bacteria or pathogens to streams. There is very little human occupation in the analysis area, except for some residences along the Gardner Ridge and Lewis Roads.

Beaver are notably absent from the analysis area and, therefore, coliform bacteria from this species is not expected. There is not enough information to formulate a reference condition**.**

***What are the influences and relationships between water quality and other ecosystems processes in the analysis area?***

<u>Relationship of Turbidity to Floods, Landsliding, and Sediment Delivery/Routing</u>
The Non Point Source Assessment (ODEQ 1988) indicates turbidity, sediment, and dissolved oxygen as a moderate problem for the North Fork Chetco.

Landslides are the most important process in delivering sediment to streams in the analysis area and decreasing water quality. From a calculated landslide rate for the period 1940-1992, the Cassidy drainage is the most sensitive at 19 slides/ 1000 acres. Although the landslide rate is the highest of all drainages, the sediment transfer index is relatively low. This could mean that some of the slide materials are in storage as debris fans or terraces or delivered slide volumes are lower. The Bosley, Lower Chetco, and Middle NFC drainages fall into the second most sensitive landslide rate class with 9 to 11 slides/1000 acres. These drainages have high sediment transfer and sediment is routed through the drainages quickly in response to storms. Sediment may be moving in waves through the North Fork Chetco and out to the main Chetco River, estuaries, and eventually, the ocean. Landslide frequency peaked around 1970, and recent slide incidence more closely matches a pre-harvested condition (refer to Section III.5-Erosion Processes). Therefore, an improving trend for water quality is suspected. The November 1996 flood was the second highest on record in the analysis area and occurred without appreciable sliding. This seems to be further evidence that the analysis area is recovering with the regrowth of forest vegetation. Poor water quality, indicated by turbidity, is still high during storms, but clears quickly as the streamflow recedes several days later.

Runoff from roads and compacted areas as concentrated or overland flow or ditch runoff is causing erosion and is the second most important process in decreasing water quality. Bosley and Upper Bravo drainages have higher precipitation amounts, occasional snow, and are more sensitive to sediment delivery. No quantitative estimates have been formulated. Road decommissioning or improvement may reverse this trend.

Aquatic habitat can be degraded with movement of sediment materials. The sediment covers fish spawning areas, reducing oxygen to fish eggs and thus reducing populations. A constantly shifting streambed could make colonization by macro invertebrates or Pacific giant salamanders more difficult. Other stream processes that are affected include nutrient cycling related to the woody materials in the stream environment.

<u>Relationship of Water Temperature to Riparian Cover</u>

On BLM lands, the Aquatic Conservation Strategy and pattern of Riparian Reserves on intermittent and perennial stream channels will provide thermal control by shading the streams, except in cases of natural disturbance. Stream temperatures on intermittent streams on private lands in the analysis area will continue to be elevated where regeneration harvest is occurring, unless streamside shade is restored. Water temperature in seeps and springs are primarily dependant upon the underground soil/rock unit temperature.

<u>Relationship of Water Quality to Fire</u>

After higher intensity fires, where it burns across or backs down into stream channels, increased sediment delivery will result for several years. Channels could also release sediment stored behind LWD that is consumed. Channels could headcut and chronically access a new source of material until a solid stream base level is established. If the canopy is burned, stream temperature will increase and this affects water quality for a longer period of time, until shade becomes reestablished.

***What is the management objective for water quality the analysis area?***

The management objective is for clean, cool water that fully supports beneficial uses and meets or exceeds Water Quality Standards for the South Coast Basin, or as amended by basin wide standards or criteria referred to in "Oregon's Criteria for Listing Waterbodies" (ODEQ 1996a). It also includes ensuring that actions do not degrade water and meets Oregon's Antidegredation Policy. Soil and Water Conservation Practices, implemented as a Best Management Practice (BMP) design for a project will be carried out to meet Oregon's water quality goals. The *Northwest Forest Plan FSEIS* and *Coos Bay District's 1995 Resource Management Plan Appendix D* list many of these BMP's to be routinely used in management actions.

## IV.2 AQUATIC HABITAT

The aquatic habitat is directly dependant upon the different types stream channels found within a watershed. To better understand this relationship, this Section will first discuss the types of stream channels found in the analysis area and the differing processes effecting them.

***What were the historical conditions and trends of the stream channel types represented in the analysis area?***

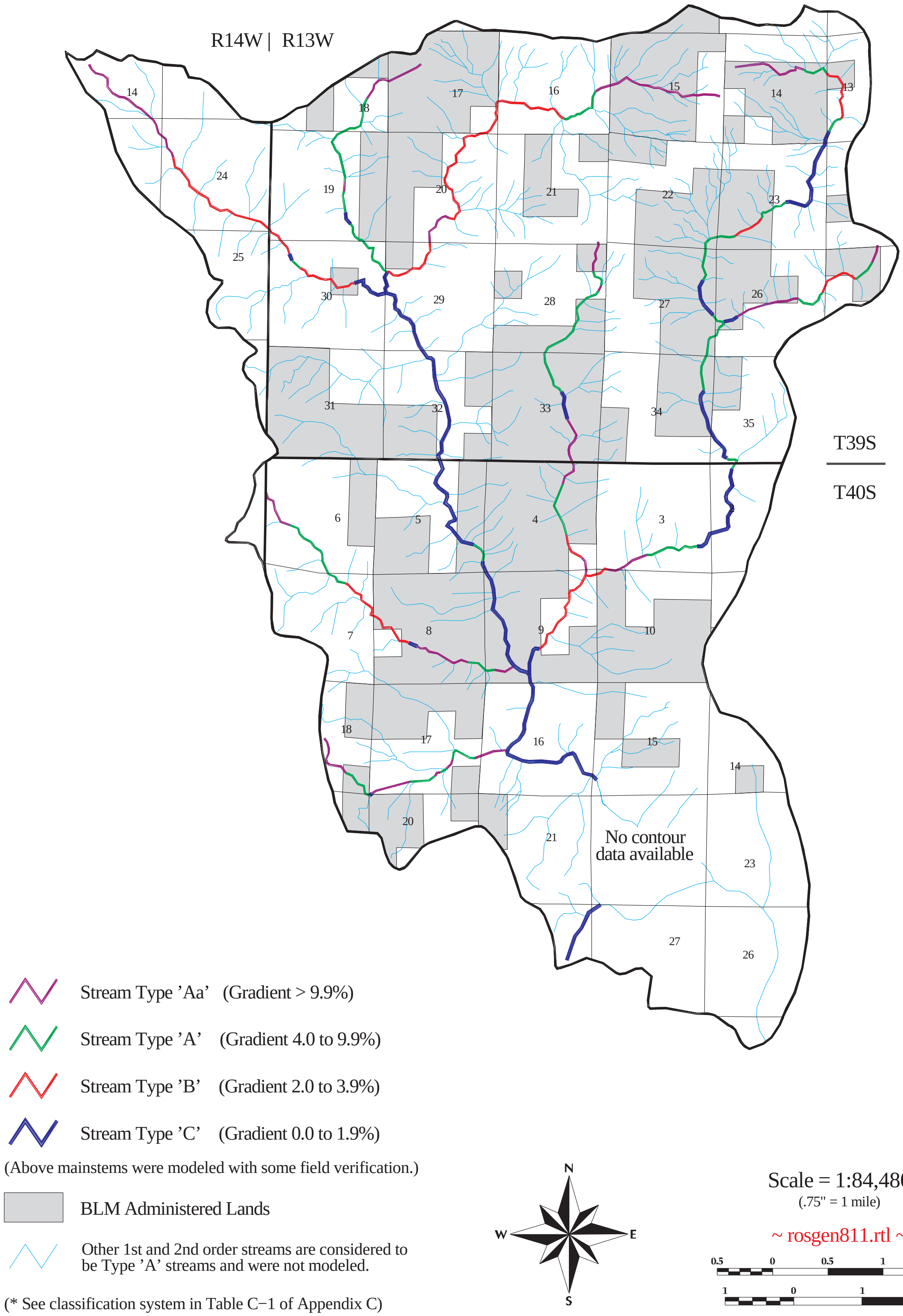
Stream types can best be described by stream channel similarities and differences. Rosgen classification system was used as a basis for comparisons (Rosgen 1994). Table C-1, Appendix C shows a brief outline of this classification system and hydraulic relationships, for stream types found in the analysis area. Figure IV-5 shows generalized Rosgen Stream Types for the North Fork Chetco analysis area.

<u>High Gradient Channels, Rosgen A and Aa Stream types</u>
These high gradient A (4-10%) and Aa (10%+) stream channels are usually 1$^{st}$ and 2$^{nd}$ streams. Streams in unmanaged timber stands are still representative of the historic condition.

<u>Moderate Gradient Channels, Rosgen B Stream types</u>
These moderate gradient (2-4%) transitional stream channels are usually 3$^{rd}$ and 4$^{th}$-order streams. Few reference areas remain in the analysis area. This channel type contained steps formed by boulders and large woody debris (LWD) that are critical to maintain stream energy dissipation and prevent lateral adjustment and bank-cutting. Embedded LWD spanning the channel creates low velocity flats onto which sediments are deposited for long term storage.

<u>Low Gradient Channels, Rosgen C Stream types</u>
These low gradient (<2%) stream channels are usually 4$^{th}$-order and greater streams. The probable historic condition for these channel types included streams that were narrow, unconfined by the stream bank at flood stage, and readily accessed adjacent floodplains during high flows. Their stream banks were stabilized by root masses including maple, cedar and other tree species. Although there may have been greater amounts of downed LWD in these channel types historically than at present, living trees were primarily responsible for maintaining bank

# Figure IV−5 ROSGEN * Stream Channel Types



stability. These channels dissipate energy by meandering and flowing over roughness elements along the banks and streambed.

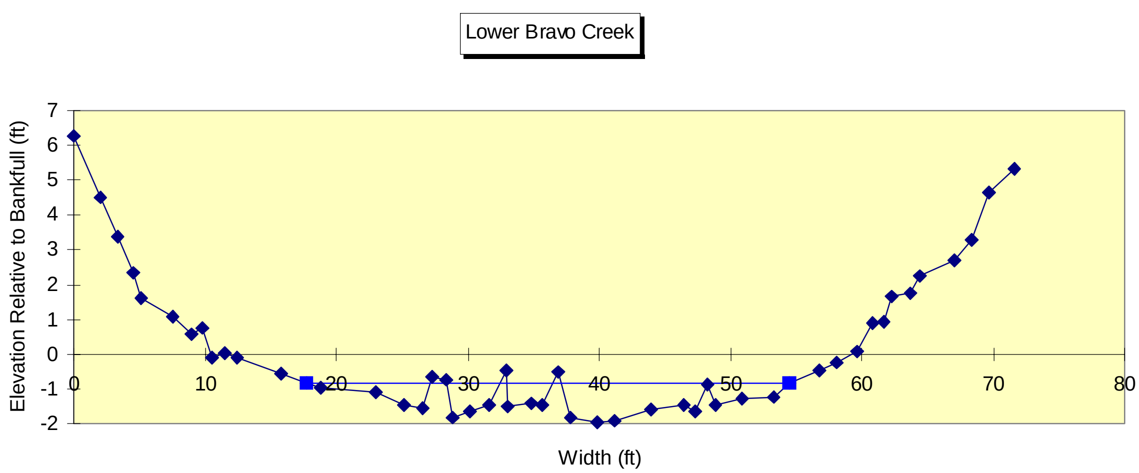
***What are the current conditions and trends of stream channel types with respect to the sediment transport and deposition processes prevalent within the analysis area?***

Stream Channel Classification and Current Condition

Each of the 11 drainages in The North Fork Chetco analysis area were inventoried in the field. During these inventories, typical cross sections of the channel were measured, pebble counts of the surface substrate of the channel bed were conducted, and longitudinal profiles of the channel gradient were created. Figures IV-6 through IV-8 show examples of the results. This data, when looked at together, gives important information about stream channel characteristics and aids in channel classification. Figures for additional drainages and the location of the sample sites can be found in Appendix C-2.

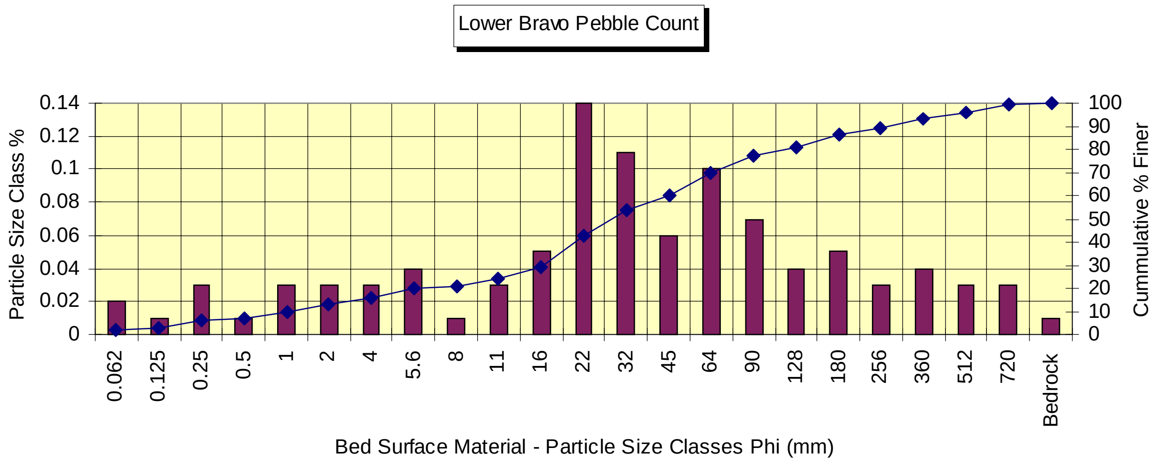
A typical cross section was measured with a tape and rod in the lower portion of each drainage in a low gradient (<2%), Rosgen B3c or C-type channel, at a site representative of the reach (Figure IV-6). The cross section contains information about bankfull width, depth and cross sectional area, and whether a floodplain is present above bankfull elevation.

**Figure IV-6 Typical Cross-Section**



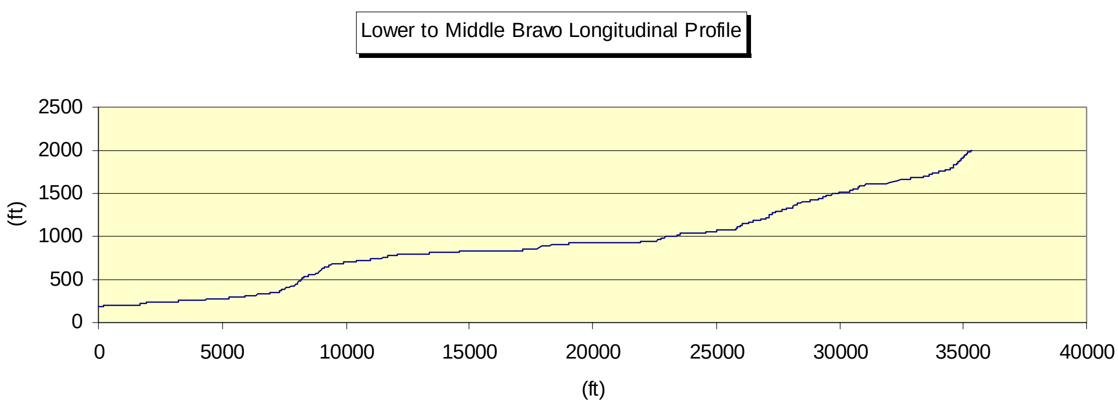

A pebble count of the streambed substrate was taken in the same area and covered riffle and pool sections (Figure IV-7). The sample is stratified within low gradient stream types. More replicate samples could be taken to determine confidence and trend of the data.

**Figure IV-7   Typical Pebble Count Analysis**




Longitudinal profiles of the stream channels were developed for each drainage by intersecting GIS contour and hydrography coverages (Figure IV-8). These profiles give a picture of the stream gradient which can be used to aid in stream classification.

**Figure IV-8   Typical Longitudinal Profile**




<u>High Gradient Channels, Rosgen A Stream types</u>

These are steep, V-shaped, erosional, relatively straight channels which lack a floodplain. Many are confined by bedrock channels and steep banks. About 124 miles (72%) of all channels in the analysis area fit this type. The main processes affecting these channels are infrequent landsliding and debris torrents. Review of past aerial photography indicates that although incidences of debris avalanches and debris slides into channels have increased from forest management, rapid movement down 1st and 2nd-order channels by torrenting has probably not been accelerated (refer to Section III.5-Erosion Processes).

A1a+ stream types are steep (>10%) stream types on bedrock and prone to the debris avalanche and shallow rapid debris flow process. The avalanches, debris slides and resulting torrents usually occur when concave hollows on headwalls above these channels are loaded with colluvium, soil materials and organic debris by natural or disturbance processes. When prolonged precipitation saturates thin soils, shear strength is reduced and failures are likely. This has been observed to be associated with the 5-10 year (or greater) recurrence interval storm. Shallow rapid debris torrents travel at 25-40 mph and are devastating to low-order channels. They are responsible for scouring bed and banks, carrying huge volumes of sediment, and leaving depositional fans at high angle, tributary junctions. This perpetuates the A1a+ channel type, by passing large debris, gravels, and sediments downstream to higher-order depositional stream types. This process occurs on an infrequent basis.

Moderate Gradient Channels, Rosgen B Stream types

These are moderately sloped, slightly meandering channels which either lack a floodplain or have very limited development. About 27 miles (16%) of all channels in the analysis area fit this type. Most B stream types are perennial. The main processes affecting these channels are the input of water, sediment and LWD from upslope channel segments, and some bank cutting, shallow rapid slides from adjacent hillslopes and entrenchment. Much LWD has been removed from this channel type, but energy dissipation is still occurring because of a high boulder component creating step/pools. Sediment is being accessed from streambanks, hillslope failures, and A-type channels upstream; it is temporarily stored behind obstructions or on localized flats where natural stream grade controls are present. Where stream slopes exceed about 2%, fine and coarse sediments are moving downstream during frequent flows. This stream type will not aggrade, even when sediment supply is high.

Low Gradient Channels, Rosgen C Stream type

This is a low-lying, meandering, wide and slightly entrenched to entrenched channel with a variety of substrates. About 21 miles (12%) of all channels in the analysis area fit this type. All C channels are perennial. These channel types are located lower in the drainages, along $4^{th}$ to $5^{th}$-order streams and have larger contributing areas. This includes middle and lower North Fork Chetco, as well as some reaches of Bravo Creek. These stream types can easily be identified in longitudinal profiles shown in Appendix C-2. The main processes affecting type-C channels are the input of water and sediment from upstream channels (type-A and B streams), hillslope shallow rapid failures, and instream lateral and vertical adjustments through bank cutting and channel scouring.

This low gradient channel type is ordinarily a depositional area for fine sediments (sand size or smaller). However, pebble counts and observations indicate that type-C reaches in all drainages contain a low proportion (<10%) of bed material in this size category. The highest count of surface bed material sand size or smaller was 13% in the Lower North Fork Chetco drainage. It appears that high winter stream flows and flow velocities are quickly exporting smaller bedload materials (sand size and smaller) from all channel types within the analysis area. Pebble count diagrams for all survey sites are in Appendix C-2.

***What are the natural and human causes of change between historical and current channel conditions?***

Some effects on stream channels from forest activities do exist. There are approximately 216 stream crossings (road-stream intersections) in the analysis area. Some of these crossings have changed channel conditions locally by creating nickpoints, or have failed causing lateral migration of the channel. Some road ditches have extended the stream network of some low order channels. No quantitative estimates of channel extension or increase in runoff volume (due to roads) have been made. However, such increases are thought to have little effect on channel stability and aquatic habitat because stream channels here do not appear to be sensitive to runoff degradation by extra flow.

Shallow rapid hillslope failure directly adjacent to stream channels is a natural process that has been accelerated by clearcut harvesting. These failures have partially blocked and narrowed channels, or have caused lateral bank cutting. They are most pronounced in the valley bottom canyons along low gradient mainstem stream segments (refer to Section III.5-Erosion Processes). Because the mainstem streams are within canyon land forms that have resistant beds and upper banks, channel migration has been minimal.

Landslides affect sediment supply in streams in various ways. For example, if too few slides occur, the stream system may become starved for gravels and channels start to downcut or make lateral adjustments. Conversely, if the sediment supply is too great for the stream to handle, bar formation or aggradation may result.

The additional sediment that comes from harvest and road-related slides would have changed the routing process in comparison to a natural rate throughout the downstream sections. A portion of these same slides would have delivered as natural slides to the analysis area over time.

Examination of aerial photography for the 1950-1970 period reveal that slides contributed greater volumes of sediment. High instream water velocities during winter flows would have rapidly moved much of the fine sediment downstream and out of the analysis area. Coarse sediments have more resistance to movement and probably resulted in aggradation of some stream channels.

Given the added sediment from management activities, the removal of this sediment from high transport hazard channels must be analyzed for downstream impacts. Deposition of the sediment in high deposition hazard channels downstream could inundate flood plains of the lower gradient channel. This can affect both channel aggradation and stream habitat. Materials coming from road and harvest-initiated slides may only have affected the routing process in the Lower Bravo drainage. This drainage has a high deposition hazard and moderate transport index; thus, the movement of additional sediment may not have been routed as it had in the past. Bosley and Middle NFC drainage also have been affected by high numbers of landslides, but due to the ability of these streams to move large quantities of sediment downstream, they may not have had the deposition expected based on the deposition hazard rating.

Debris torrents are more infrequent than other landslide types in the analysis area (refer to Section III.5-Erosion Processes). Sediment is accrued by hillslope failures, bank undercutting and ravel. The A and B stream types, because of their steep gradients, rapidly transport coarse and fine sediment through them. Mid-slope roads acting as interceptors, channel landform constrictions, boulders, LWD, and debris torrent deposits can slow the routing process. Once a new equilibrium is established below obstructions, incoming sediments will be held in suspension during the frequent flows and moved downstream.

Type-C channels are low gradient, and the active channel dimensions are maintained by the frequent flows. Shallow rapid landslides from stream-adjacent deliver the majority of coarse and fine sediments in this stream type. Although the sediment supply is high, the surface streambed armor layer does not appear to be overwhelmed with fine sediments. A large percentage of coarse and fine sediments are near the bank-full stage at the margins of the active channel or absent. This implies sediment transport is flow limited rather than supply limited.

High volumes of water and discharges have caused some bank undercutting along the North Fork Chetco and Bravo Creek mainstems.

***What was the historical condition and distribution of aquatic habitats throughout the analysis area? What is reference condition for aquatic habitat?***

With the exception of forestry operations, the North Fork Chetco analysis area is virtually undeveloped upstream of Sections 14, 15, 23 and 26 of T.40 S.,R.13 W. Residential development in these sections is rural, sparse, and localized along the lower mile of the river and along Gardener Ridge Road. Late 19$^{th}$ and early 20$^{th}$ century human impacts to aquatic and riparian habitats included grazing, logging, small-scale road-building, fires, and mining. There were no splash dams in the analysis area or in the Chetco River. Farnell (1981) indicated that while the lower mainstem Chetco River was used for log drives around the turn of this century, such occurrences were small-scale and infrequent; none were recorded for the North Fork Chetco River. Later in the century, widespread timber harvest, road building, and fire suppression were common.

The earliest accounts of the Chetco River were provided by Lt. Francis R. Shunk of the U.S. Army Corps of Engineers in August, 1892 (U.S. Chief of Engineers (1893), as quoted in Farnell (1981)). This report noted that "After heavy rains the water rises to a 10-foot stage; at such times great quantities of logs, trees, and debris are brought down [the river]" and "There is plenty of timber - fir, spruce, myrtle, and tan oak." Skunk also noted that the population of the whole Chetco valley was not more than 100; there were no settlements other than the small town of Chetco at the mouth of the river, and very little commerce (U.S. Chief of Engineers 1893).

It is difficult to determine the historical condition of aquatic habitat because quantitative surveys and measurements of aquatic habitat prior to 1970 have not been located for the North Fork Chetco analysis area and probably do not exist (Appendix C Table C-4). However, reference condition for aquatic habitat probably best corresponds to areas of contiguous BLM ownership and with riparian reference condition sites listed in Table IV-7 (Section IV.4-Riparian Habitat).

Although these reference reaches have received little or no direct management, their respective aquatic habitats may have been altered from natural conditions by human impacts upstream (e.g., harvest or road-related landslides, debris torrents).

***What is the current distribution and condition of spawning and rearing habitat for fish, including likely 'hot-spots'? How are these habitats maintained? How have human activities affected these habitats?***

Distribution of Fish-Bearing Streams

The North Fork Chetco analysis area contains approximately 14 miles of anadromous and resident fish-bearing streams, and an additional 18 miles containing only resident fish (Figure IV-9). Total miles of anadromous fish distribution may vary yearly, based on habitat and flow conditions.

For anadromous fish, access to spawning and rearing habitat in the analysis area is thought to be limited by only *natural* barriers or habitat conditions:

- *Mainstem North Fork Chetco*: boulder canyon with multiple falls (Sec. 4-5)
- *Bravo Creek*: boulder canyon and falls (Sec. 3)
- *Ransom Creek*: high gradient cascades (Sec. 33)
- *Mayfield Creek*: high gradient (Sec. 17)
- *Cassidy Creek*: high gradient (Sec. 30)

For resident fish, access to habitat is primarily limited by natural barriers (high gradients or cascade/falls). In some streams, numerous passable obstacles cumulatively restrict the upstream distribution of fish. The only known human-caused barrier to fish migration is a culvert on the northern tributary to Mayfield Creek (Sec. 17, NW 1/4, NW 1/16). Although resident cutthroat trout were observed upstream of the culvert, it is a barrier to upstream movement.

Aquatic Habitat Inventories

Formal aquatic and riparian habitat surveys in the North Fork Chetco analysis area began in 1972 and were conducted periodically thereafter (Appendix C, Table C-4). These surveys estimated stream substrate composition, pool abundance, shade, water quality (temperature, flow, clarity), fish species and abundance, and natural barriers. The surveys also noted numerous stream-side landslides and the presence of various aquatic and terrestrial fauna; beaver habitats were among those not noted. Debris jams were encountered infrequently during these surveys.

During the summer of 1995, the BLM conducted intensive aquatic habitat inventories (using ODFW methods) in the analysis area (ODFW and BLM, 1995). Data collected during these surveys was used to evaluate streams in relation to ODFW habitat benchmark criteria (Table IV-3). It is difficult to compare 1995 data with earlier surveys, because data were collected using different methods and for different objectives. However, adequate pool area (%), infrequent wood jams, clear water, and presence of stream-side slides were features noted in both the 1970's and 1995 surveys. (Location of the surveyed stream reaches found on Figure IV-10).

# Figure IV−9  Anadromous and Resident Fish Presence

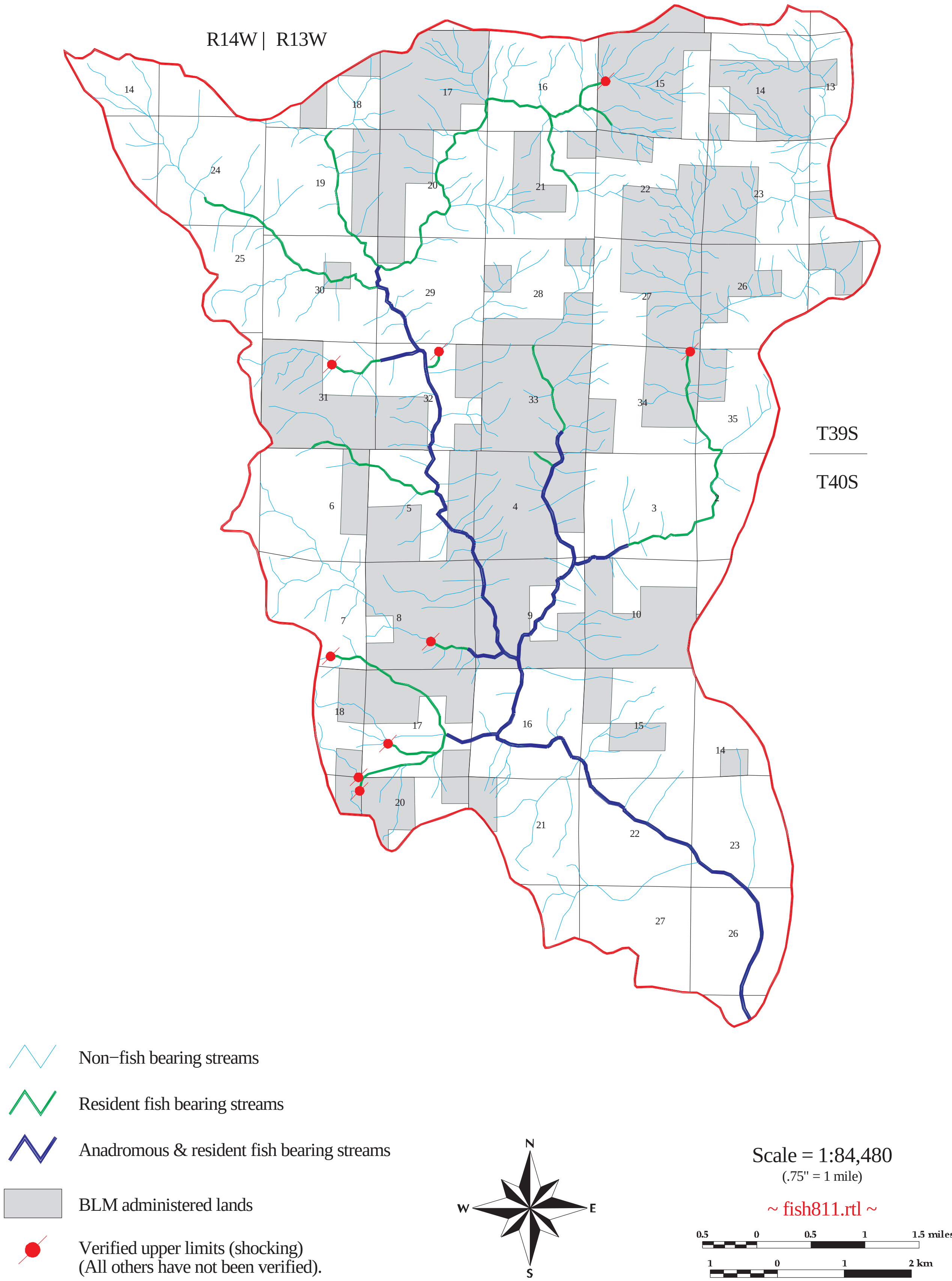


**Table IV-3 Comparison of habitat conditions in North Fork Chetco and surveyed tributaries against ODFW Habitat Benchmarks as adapted by BLM reference site data (2).** Data was collected during summer, 1995.

"Good" habitat conditions (2) based on values from surveys of reference areas with known productive capacity for salmonids and from the upper 65th percentile of values obtained in surveys of late-successional forests. "Poor" habitat conditions based on values associated with known problem areas and from the lower 25th percentile of combined data for each region. "Fair" conditions lie in-between.

= [white box] Good Habitat Conditions (2) [light grey box] =Fair Habitat Conditions [dark grey box] =Poor Habitat Conditions

| Benchmark Criteria | North Fork Chetco River | | | | | Bravo Creek | | | | | | Bravo Trib A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REACH | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 6 | 1 |
| Pool Area (%) | 32 | 58 | 45 | 33 | 26 | 29 | 21 | 43 | 36 | 39 | 39 | 28 |
| Pool Frequency (# chan. widths/pool) | 6.1 | 3.5 | 3.2 | 5.2 | 6.2 | 6.2 | 4.2 | 3.1 | 2.9 | 4.5 | 5.2 | 2.8 |
| Residual Pool Depth (m) (scour pool depth minus riffle depth) | 1.0 | 0.9 | 1.0 | 1.0 | 0.3 | 0.6 | 0.5 | 1.7 | 0.9 | 0.5 | 0.6 | 0.4 |
| Width-to-Depth Ratio (in riffles) | 39.3 | 21.7 | 19.6 | 37.2 | 18.8 | 25.3 | 16.2 | 30.0 | 15.6 | 26.3 | 20.3 | 11.1 |
| Silt, Sand & Organics (% area in riffles) | 6 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gravel (% area in riffles) | 91 | 26 | 23 | 14 | 21 | 15 | 18 | 80 | 65 | 41 | 10 | 15 |
| LWD (1) (pieces/100m) | 4 | 2 | 5 | 6 | 28 | 3 | 6 | 15 | 24 | 23 | 8 | 27 |
| LWD (1) (volume/100m) | 1 | 2 | 10 | 6 | 19 | 8 | 19 | 46 | 21 | 17 | 21 | 16 |
| "Key" Pieces LWD (#/100 m) (>60 cm dia. & ≥10 m long) | 0 | 0.1 | 0.5 | 0.1 | 0.4 | 0.2 | 0.7 | 1.8 | 0 | 0.3 | 0.3 | 0 |
| Riparian Conifers (2) (#>20" DBH/1000 ft) | 30 (0) | 0 (2) | 0 (32) | 0 (6) | 0 | 0 | 0 | x | 0 | 30 | 122 | 30 |
| Riparian Conifers (#>35" DBH/1000 ft) | 30 | 0 | 0 | 0 | 0 | 0 | 0 | x | 0 | 30 | 0 | 0 |

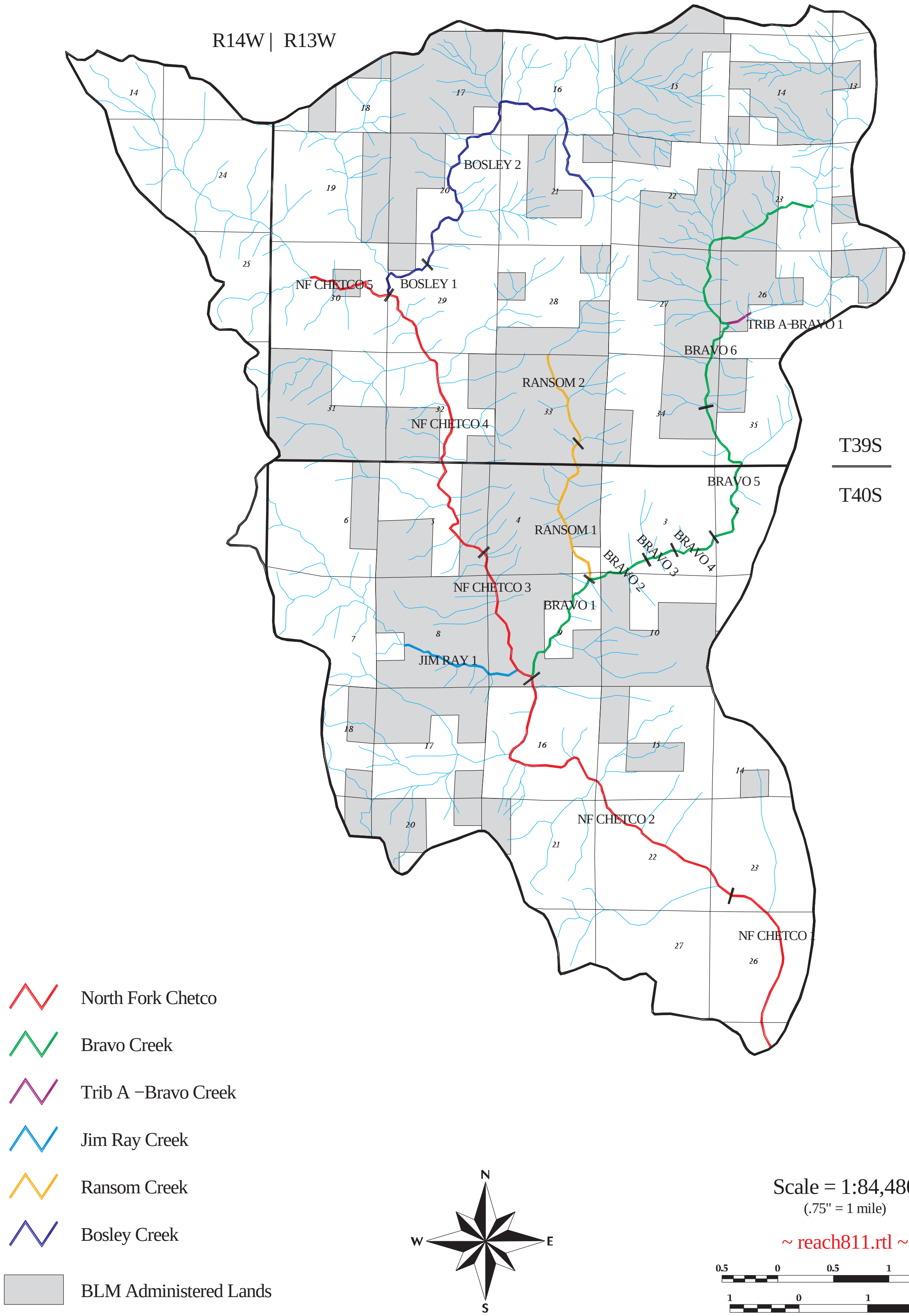
**Table IV-3 ( continued)**

| **Benchmark Criteria** REACH | Ransom Creek | | Jim Ray Creek | Bosley Creek | |
|---|---|---|---|---|---|
| | 1 | 2 | 1 | 1 | 2 |
| Pool Area (%) | 18 | 35 | 23 | 21 | 36 |
| Pool Frequency (# chan. widths/pool) | 6.6 | 6.3 | 3.9 | 6.8 | 4.8 |
| Residual Pool Depth (m) (scour pool depth minus riffle depth) | 0.4 | 0.4 | 0.5 | 0.6 | 0.4 |
| Width-to-Depth Ratio (in riffles) | 13.3 | 22.3 | 12.3 | 22.3 | 24 |
| Silt, Sand & Organics (% area in riffles) | 0 | 0 | 0 | 0 | 2 |
| Gravel (% area in riffles) | 7 | 29 | 39 | 13 | 11 |
| LWD [1] (pieces/100m) | 9 | 7 | 16 | 14 | 9 |
| LWD [1] (volume/100m) | 47 | 20 | 6 | 47 | 26 |
| "Key" Pieces LWD (#/100 m) (>60 cm dia. & ≥10 m long) | 1.2 | 1.0 | 0.1 | 1.7 | 0.8 |
| Riparian Conifers [2] (#>20" DBH/1000 ft) | 81 (30) | 122 (30) | 142 (15) | 0 | 0 |
| Riparian Conifers (#>35" DBH/1000 ft) | 81 | 61 | 61 | 0 | 0 |

(1) LWD - minimum piece size 15 cm diameter, 3 m length; exception is rootwads with cut ends which may be <3 m long.

(2) Riparian Conifers - standards for "good" (data in parentheses) were based on reference reach data collected in the 1995 riparian inventory (BLM 1995; data on file in the Myrtlewood Resource Area, Coos Bay District BLM). This was a separate and more intensive inventory (counted all trees - 100% of reach length) than the ODFW survey (counted trees in transects - sampled 0.45% of reach length) (ODFW/BLM Aquatic Habitat Inventory Project, 1995). Where density was high, ODFW method overestimated conifer tree density by 27-800%; where density was low, ODFW method underestimated conifer tree density. Ransom Creek reaches 1-2, NF Chetco reach 3, and Bravo Creek reach 6, are considered old-growth "reference sites," and are representative of riparian stands in a natural disturbance regime.

# Figure IV−10  1995 Habitat Inventory Stream Reaches



In addition to the aquatic inventories, the BLM conducted a more intensive riparian vegetation inventory adjacent to major streams, including the North Fork Chetco mainstem, Jim Ray Creek, and Ransom Creek (BLM, 1995). This was a separate and more comprehensive inventory of riparian vegetation that was *not* part of the ODFW aquatic habitat survey. This BLM inventory more accurately represented riparian condition, because 100% of riparian trees (within 100 feet of the stream) were counted; the ODFW method counted trees in transects, sampling only 0.45% of stream length. Conifer stem densities derived from this data are shown in parentheses along with the aquatic habitat data in Table IV-3. Where density was high, the ODFW method overestimated conifer tree density by 27-800%; where density was low, the ODFW method underestimated conifer tree density. (refer to Section IV.4-Riparian Habitat for additional discussion of riparian vegetation composition and reference sites).

Although management activities in the analysis area have affected habitat factors represented in Table IV-3 at specific sites over the last century, their cumulative impacts on the system's capacity to support fish populations analysis area-wide are unknown.

Spawning & Incubation Habitat

The quality of spawning habitat is affected by substrate composition, bedload movement, cover, and water quality and quantity. Successful incubation depends on extra- and intra-gravel chemical, physical and hydraulic variables (dissolved oxygen, water temperature, amount of fine sediment, etc.).

Although the location of specific 'hot-spots' are unknown, spawning and habitat surveys indicate that spawning for anadromous fish is concentrated along all Rosgen type-C and some type-B channels downstream of natural barriers (Figure IV-5). These channel types are generally 0-4% gradient, and have abundant gravel available for spawning. Chinook salmon, coho salmon, steelhead trout and Pacific lamprey spawn in reaches 1-3 of the North Fork Chetco River mainstem, downstream of a natural boulder canyon (Figure IV-10). Based on relatively high spawner densities, the lower 1.2 miles of the North Fork Chetco River could be considered a 'hot-spot' for spawning chinook salmon (surveys conducted since 1989; data on file at ODFW, Gold Beach OR). Although precise distribution is unknown, steelhead, sea-run cutthroat trout, and Pacific lamprey also spawn in North Fork Chetco reaches 4-5, in the first reach in each of Bosley, Bravo and Ransom Creeks, and in the lower sections of several unnamed tributaries to the mainstem. High densities of spawning steelhead have been observed within a 1.6 mile survey reach upstream of Road No. 40-13-5.1; this area may be considered a 'hot-spot' for spawning steelhead (surveys conducted in 1996-1997; data on file at ODFW, Gold Beach OR). Resident cutthroat trout spawn in many small streams throughout the analysis area, while resident rainbow trout are probably limited to reaches 4 and 5 of Bravo Creek. It is likely that the amount, quality, and location of available spawning habitat for all species varies yearly according to flow conditions (depth and velocity), and sediment delivery and transport.

Aggradation (deposition) and degradation (scour) of coarse sediments in spawning areas (Rosgen type-C channels) may be a concern in this analysis area. Low gradient, Rosgen type-C channels, are depositional areas, and could be prone to aggradation of coarse sediment if delivery from upstream processes exceeds the transport capacity of the reach. If such areas are used for spawning, the redds are more likely to be disturbed by flows that displace or bury the streambed material containing the redd.

Channel aggradation may contribute to intermittent channel drying (i.e., flow goes subsurface during the summer). A habitat survey of the North Fork Chetco conducted in Aug-Sep, 1982, described the first ½ mile as intermittent (i.e., a series of scour pools separated by dry gravel). The only pools present were small and associated with in-stream boulders and woody structure. This condition was also observed periodically during the 1990's. In addition, notes taken by U.S. Government surveyors on Sept 24, 1875, indicated that the North Fork Chetco River was dry near its confluence with the Chetco River in T40S-R13W-Sec 35, North ½ (Curry County Surveyor's Office). It is unknown whether this condition was a result of drought, aggradation of sediments, or a combination of factors. However, channel drying appears to be within the natural range of variability for the lower reach of this analysis area.

The rate of landslides and debris torrents increased after 1940 and peaked between 1955 and 1970. Although the analysis area appears to be recovering from these disturbances, the landslide rate remains slightly elevated from pre-harvest periods. It is presumed that the elevated rates by 1970 increased sediment delivery to stream channels and subsequent channel aggradation. Channel widening, braiding, bar construction, frequent stream bank failure, and pool filling by unsorted bedload are all indicators of an aggrading stream (Lisle 1987). Channel widening was observed from the 1970 aerial photos, while marginal pool depths, width/depth ratios, and riffle gravel values were indicated from the aquatic habitat inventory (Table IV-3). Although some channel recovery is evidenced by regrowth of riparian vegetation on exposed surfaces, there may be some question as to whether stream channels have transported all the excess sediment from the system so as to be considered fully recovered.

Fine sediment is not a limiting factor for egg incubation in this analysis area. Habitat inventories (1995) and pebble counts conducted in the analysis area indicated that gravel riffles in Rosgen C-type channels (assumed to be used as spawning habitat) contained a very low amount of sand, silt and organic matter.

<u>Rearing Habitat</u>
For a given number of spawners and seeding level, habitat conditions that set carrying capacity for rearing include stream productivity, abundance of certain habitat types (such as pools), and the quality of those habitats (i.e., complexity, water velocity and depth, and water temperature, turbidity, and chemistry). Fish rearing potential in the mainstem North Fork Chetco (reaches 1-4) and in Bravo Creek (reach 1) is limited for several reasons:

- high summer water temperatures (refer to Section IV.1-Water Quality)
- high winter flow and velocities, and low summer flow
- lack of complex pool habitat and large wood
- lack of deep pools
- hillslope constraints and shortage of floodplains

In general, pool area and frequency rate as fair to good throughout all inventoried reaches in the analysis area (Table IV-3). However, deep pools (>1 m) are rare, and residual pool depth in reference reaches (North Fork Chetco reach 3; Bravo Creek reach 6, and Ransom Creek reaches 1

& 2) rated fair to poor.  In addition, nearly all of the pools present are scour pools; backwater, alcove, and beaver dam pools are very rare or absent in the analysis area.  Scour pools, unlike backwater, alcove and beaver dam pools, are erosional at high flows and therefore do not provide suitable winter rearing habitat for most salmonids.  In particular, juvenile coho salmon avoid high velocity (scour) pools at high flows and instead utilize backwater, alcove and beaver dam pools (Nickelson et al. 1992a  and 1992b).

Structural complexity, in the form of wood or boulders, is an important feature of rearing habitat for salmonids, especially coho salmon and cutthroat trout.  While abundance of boulders and boulder cover are high throughout the analysis area, structurally complex pools resulting from large wood, are limited or non-existent.  For example, the average woody debris complexity score for most reaches surveyed in the analysis area ranged from 1.2-2.5 (1=low, 4=high); this corresponds to very low wood abundance, creating little or no habitat complexity or complex flow patterns.  Such reaches are ineffective at providing cover at moderate to high discharge.  Additionally, complex pools (with wood score $\geq$ 4) were non-existent.  For this reason, overwintering habitat for coho salmon is probably limiting.  However, because even “reference condition“ riparian reaches (i.e., unharvested, mature and old-growth stands) have low abundances of large wood, lack of complex pool habitats may be a natural limiting feature.

Stream channel aggradation resulting from landslides can impact summer rearing habitat for resident and anadromous fish.  For example, one landslide delivered high quantities of coarse, angular material to the channel, and temporarily aggraded the stream bed to a depth of six feet, for a length of 300 feet (ODFW and BLM 1995).  This resulted in an absence of surface flow in the affected area during late summer, and the isolation of cutthroat trout and juvenile steelhead, all of which perished over a one week period as flow receded and water temperature increased.  Such impacts are a primary concern in regard to road construction and timber harvest in unstable areas, especially adjacent to stream channels.

***What effect have changes in channel morphology and riparian vegetation had on summer low flows?***

Changes in channel morphology and riparian vegetation have affected low flows.  Removal of forest vegetation has been shown to increase low flows by reducing evapotranspiration (Harr et al. 1979). Conversion from conifer to hardwood tree species such as tanoak or red alder, can actually decrease summer low flows from preharvest conditions because these species transpire more water during the summer low-flow period and acts as phreatophytic vegetation.  No studies quantifying summer water loss in streams due to species conversion have been thoroughly studied (Beschta, 1996).  It is not known what changes have occurred in low flow stream discharge during the years of intensive harvest (1950-1970), because of the lack of streamflow records.  However, most low flow changes are thought to have been slightly elevated or beneficial to the aquatic ecosystem.

Morphological changes affecting the retention of low flows has been slight.  LWD is not as important a contributor to pools and low flow pool retention, as other Coast range analysis areas because of the abundance of boulder and coarse substrates in forming and maintaining pools. However, C stream types in the analysis area need LWD to form and maintain quality pool depths.

Permanence of LWD in this stream type may be a problem, because high flows and few jam forming elements will allow this material to be swept downstream.

***What are the influences and relationships between channel conditions and other ecosystem processes in the analysis area?***

Channels are receptors of upslope processes. Much sediment was delivered coinciding with roading and harvest between 1940-1970. Two big floods in this period (1955 and 1964) no doubt contributed to landsliding (refer to Section III.5- Erosion Processes). Observations between successive aerial photograph years beginning in 1940 show sediment deposition and channel widening in the mainstem channels. Channel aggradation probably occurred during those years and may have persisted until the early 1980's. Eventually the stream flows were able to move much of the excess coarse sediments downstream.

Large scale fire, like the 1939 fire occurrence near Bosley Butte, allowed pathways for increased sediment delivery and may have elevated tributary flows for a period of time (refer to Section III.7- Disturbance Processes). Instream LWD removal, whether by timber salvage or fire may have allowed some channel adjustments (refer to Section IV.4-Riparian Habitat). Functions of large wood may be important in maintaining quality pools in Rosgen C channels.

***What are the influences and relationships of aquatic and riparian habitats with other ecosystem processes (e.g., sedimentation, vegetation, large wood delivery, stream productivity)? How have human activities affected aquatic habitat?***

Large Wood

Riparian reaches which best approximate “reference condition“ (i.e., unharvested, mature and old-growth stands) have low abundances and sparsely distributed pieces and clusters of large wood (Table IV-3). Although direct comparisons are not possible due to differing data standards, the large wood abundances observed in the North Fork Chetco analysis area appear to be within the range observed in the remainder of the Chetco River (USFS 1997). Large wood may be naturally limited in the North Fork Chetco analysis area for two reasons:

- *Low Recruitment Potential*- Riparian stand-disturbing fires and stream-side landslides have created a highly variable mosaic of tree sizes and age classes, with very low levels of forest floor woody material (Table V- 3). Due to repeated fires, large wood abundance on the forest floor is rare (both in riparian areas and upslope), and it is unavailable for delivery to channels by landslides and debris torrents. In reference riparian reaches, large conifers >20 inches diameter are present, but in relatively low densities compared to analysis areas to the north (e.g., Coquille River). When present, large wood is usually a result of single trees or groups of trees delivered by windfall or from shallow slides immediately adjacent to the stream channel.

- *High Transport Potential* - The North Fork Chetco River is very efficient in transporting large wood, as well as sediments, downstream. Factors include high channel gradients, moderately confined channels with little floodplain (to dissipate energy) due to hillslope constraint, few land-form elements to anchor debris jams, and high runoff and flow velocities. During floods, large logs are more easily fractured into smaller pieces which are readily transported from the system.

While the disturbance regime may naturally limit large wood in the analysis area, wood abundance is probably substantially lower than it was before intensive harvest commenced in the 1940's, especially on private lands. The lower reaches of the mainstem North Fork Chetco River and most reaches along the other primary tributaries were harvested between 1940 and present (Figure V-2). These reaches are nearly void of large wood *and* large recruitable conifer trees from adjacent riparian areas.

Although “reference” reaches have received little or no direct management, conditions there may also be altered from natural conditions due to human impacts upstream (e.g., harvest or road-related landslides, debris torrents). Harvested areas deliver less large wood during debris torrents than would be expected under natural conditions. In addition, accelerated rates of debris torrents, (corresponding with peak harvest rates and floods) may have exported large quantities of woody material from some channels. Furthermore, salvage of large wood from stream channels is suspected on some BLM parcels that are accessible from private land. This was evidenced by close inspection of aerial photographs which showed the apparent removal of large logs from a debris torrent deposit between 1970 and 1976 (Bravo Creek). Aerial photos and ground inspections also indicated the presence of equipment trails in riparian areas which may have been used to salvage wood from the channel.

In the analysis area, large wood may be more important as a pool-forming element in type-C channels than in type-A and B channels. In this analysis area, type-A and B channels are generally controlled by boulders and bedrock, where these features are the primary pool-forming elements. In higher gradient channels, wood is often incorporated in jams and debris torrent deposits upstream of channel constrictions. When present as single pieces or in jams, large wood in these higher gradient channels effects local scour and deposition, but rarely forms backwater pools. In type C-channels, large wood pieces and jams can constrict flow, forming a variety of pool types, including backwater areas.

While large wood seldom offers complex rearing habitats in this system, the importance of woody material should not be discounted. Large wood serves as a substrate for macroinvertebrates, which in turn provide high quality food for fish and other aquatic species. In contrast to analysis areas to the north, gammarid amphipods are frequently noted in high densities. These amphipods are organic detritus processors, and are found on the substrate in association with woody material and accumulations of leaf and needle litter. Amphipods can occur in very high densities ($10^3$ per $m^2$), and serve as important prey for predatory fishes, such as salmonids (Thorp and Covich 1991). In reaches where macroinvertebrate communities are supported by inputs of organic material from riparian zones, removal of large wood from the channel diminishes the stream’s capacity to retain the nutrients.

Stream Productivity

Stream productivity and fish production and survival are positively correlated (Meehan et. al. 1991, Konopacky 1984, McFadden and Cooper 1962) and abundance of food (macroinvertebrates) may override even cover in determining carrying capacity of juvenile salmonids in summer months (Christensen 1996). In the analysis area, management activities over the last century have reduced the input and retention of nutrients. Intensive road-building in the drainage has likely increased sediment supply, modified runoff, and altered substrate quantity and quality. In reaches where macroinvertebrate communities are supported by inputs of organic material from riparian zones, removal of large wood from the channel has diminished the stream's capacity to retain the nutrients. Additionally, alteration of riparian vegetation during timber harvest or road-building has removed a major food source for macroinvertebrates. Typically, removal of stream-side vegetation increases incoming solar radiation, causing concomitant increases in algae-dependent macroinvertebrate populations. However, fish production in this analysis area is not likely to increase because higher water temperatures are likely to outweigh benefits from the increased food supply. Finally, diminished fish returns to the analysis area have probably resulted in lower nutrient inputs associated with anadromous fish carcasses following the spawning season.

***What is the current abundance, distribution, and condition of aquatic habitats for other aquatic and riparian associated species (e.g., herptiles, invertebrates, beaver), and how are they maintained?***

Beaver

Beaver (*Castor canadensis*) within the analysis area are primarily bank-dwellers. The steep channels, flashy hydrograph, and lack of extensive floodplains and wetlands in this system limit the potential for persistent beaver habitat (i.e., beaver ponds). There has been virtually no trapping of beaver in the North Fork Chetco area for 20 years (ODFW 1997a), so these conditions may also limit beaver abundance.

Amphibians and Invertebrates

There have been no systematic surveys of amphibian or aquatic invertebrate habitat. In addition, there is little or no information on invertebrate or amphibian habitat or communities in small ($1^{st}$-$3^{rd}$ order) perennial and intermittent non fish-bearing streams. Typically, habitat conditions important for aquatic amphibians and invertebrates (which spend some or all of their life in the water) are similar to that of fishes: water temperature and chemical composition, water velocity, stream productivity, amount of solar radiation, and physical variables such as substrate composition, habitat complexity, availability of cover, etc. (Hynes 1973, deMaynadier et. al. 1996, Nussbaum et. al. 1983). Invertebrate diversity is usually closely associated with substrate diversity and complexity of flow patterns (Christensen 1996). It is therefore assumed that natural conditions and management activities affecting instream habitat, flow patterns or riparian vegetation affect small stream communities in much the same way as the larger systems.

Macroinvertebrate community samples may be used to assess habitat quality indirectly (Rosenberg and Resh 1993). Limited data from macroinvertebrate samples collected at stations in North Fork Chetco, Bravo Creek, and Bosley Creek, 1993 through 1995, showed sample abundance, richness, evenness, and diversity were fairly high, indicating that water and habitat quality at sample sites was generally good (report on file in Myrtlewood Resource Area). Bravo Creek samples had substantially higher total abundance and EPT abundance than samples collected from the other sites, while richness, evenness, and diversity were not noticeably different. From these limited samples, it is difficult to generalize about macroinvertebrate habitat and communities throughout the analysis area because of tremendous variation inherent in macroinvertebrate samples and among microhabitat conditions across the analysis area.

Headwater Streams (1$^{st}$ and 2$^{nd}$ order)
Although most stream data collected for the analysis was within larger streams (4$^{th}$ order or greater), most of the stream miles in the analysis area are made up of small streams. Because small streams are so numerous and dissect the uplands, they are most likely to be affected by management. Persistence of these small-stream communities depends on stability of small stream channels (maintained by riparian vegetation, down wood), flow regime, and shade and detritus contributed by riparian vegetation.

Small streams are responsible for habitat quality and nutrient availability in larger tributaries downstream, and may act as refugia for aquatic and riparian-dependent organisms. Fish such as steelhead trout, Pacific lamprey and cutthroat trout are often found spawning and rearing in these small perennial systems. Small streams also provide habitat for a variety of amphibian and invertebrate species. They typically contain considerable micro-habitat diversity, producing rich biotic communities supported by allochthonous inputs from the adjacent forests. These small upland systems often contain plant and animal species not found in mainstems or in lower reaches (Tew 1971; Myrtlewood Resource Area, unpublished data on Sandy Creek, described in the Big Creek Watershed Analysis, 1997).

***What and where are the human-caused obstructions to the movement and dispersal of fish or other aquatic species? What are the implications of human-caused barriers with respect to ACS objective #9?***

Currently, only one culvert in the analysis area is a barrier to resident fish. Although resident cutthroat trout were observed upstream of the culvert on the northern tributary to Mayfield Creek (Sec. 17, NW 1/4, NW 1/16), it is a barrier to upstream fish movement.

Roads and stream-crossing structures have been shown to function as barriers to the movement and dispersal of aquatic and riparian-associated wildlife species. Road crossings can inhibit fish passage because of blockage, deterioration, or poor design (outfall barriers, excessive water velocities, disorienting turbulence, flow patterns, etc.) (Furniss et al. 1995). Many perennial streams and riparian areas in the analysis area are intersected by roads and culverts. Because most culverts are placed above the natural stream bottom, they would preclude entry by non- or poorly jumping organisms (i.e., juvenile salmonids, sculpin, herptiles, crustaceans, molluscs). This condition also leads to a lack of natural substrate within the culverts, which may preclude passage by organisms which require roughness, cover, and a precise microclimate.

Some adult amphibians are capable of overland travel and may be able to by-pass problem culverts. However, research indicates that roads may also significantly inhibit the movement of some salamander species (deMaynadier and Hunter 1995). For a Southern Torrent salamander, which is rarely found farther than one meter from a stream (Blaustein et. al. 1995, Bury pers. comm., Applegarth pers. comm), a road would likely serve as a nearly impassable barrier. Because many riparian areas in the analysis area are intersected by roads, maintenance of aquatic dispersal routes may be important not only for aquatic species, but as dispersal routes for terrestrials as well.

Barriers to the passage of certain aquatic organisms may have serious impacts on ecosystem process in small streams above barriers. Amphibians and invertebrates make up a large portion of the biomass produced in aquatic systems, contribute to the maintenance of food webs by processing vegetation and leaf litter, and increase availability of nutrients to other organisms (Christensen 1996, Taylor et. al. 1996, Hynes 1970). The presence of man-made barriers is suspected of limiting the ability of aquatic species (other than fish) to access historic habitat. The capacity of aquatic and terrestrial species to access habitats and refugia may be an important factor in ensuring survival. Movement and dispersal may also be necessary to create and maintain genetic diversity. Formerly continuous populations that become reduced in size and isolated by barriers are more susceptible to genetic, demographic, and environmental changes (Shaffer 1982, Soule 1987).

***What is the role of this analysis area within the larger 5th-field analysis area? What is the role of the 5th-field in the greater Chetco River system?***

The analysis area comprises approximately 2/3 of the acreage in the 5$^{th}$-field analysis area (Figure I-1). The lower mainstem Chetco River and Jacks Creek are the only major drainages within the larger 5$^{th}$-field that were not included in this analysis. At a larger scale, three 5$^{th}$-field analysis areas make up the greater Chetco River system. It is difficult to quantify the contribution of the North Fork Chetco to these larger analysis areas due to lack of data at all scales. The North Fork Chetco analysis area will play an important role in maintaining salmonid survival within the 5$^{th}$-field, but its influence on the greater Chetco River system is less clear. These determinations were based on several factors:

- *Key Watershed* - The analysis area contains the North Fork Chetco Tier 1 Key Watershed, as designated by the Northwest Forest Plan and Coos Bay District RMP. The Key Watershed encompasses all drainages upstream from the confluence of Bravo Creek with the North Fork Chetco River, but excludes Mayfield Creek and drainages to the south. Public lands within the Key Watershed contain significant acreage of unlogged riparian areas (considered to be in ‘reference condition’ as well as a Late Successional Reserve habitat). However, some habitat elements including deep pools and large wood are missing. “Key Watersheds that contain poor quality habitat are believed to have the best opportunity for successful restoration and will receive priority in any watershed restoration program” (page B-19 in *Standards and Guidelines for management of habitat for late successional and old-growth forest related species within the range of the Northern spotted owl*).
- *Intensity of development* - North Fork Chetco and its tributaries receive less pressure from grazing, residential and agricultural development than lands in the Chetco River valley. The analysis area and the 5$^{th}$-field contain the majority of the intensive forest lands, while Late Successional Reserves and Wilderness make up the majority of the remaining Chetco River system. At 3.6 miles/m$^2$, road density in the 5$^{th}$-field is greater than in the remaining Chetco River, but it is lower than many managed analysis areas to the north (e.g., Coquille River). While the analysis area and the 5$^{th}$-field are less vulnerable to increases in peak flow (few acres of intermittent snow zone), it will receive more intensive forest management than the remaining

lands in the Chetco River system.

- *Habitat quality and abundance* - Low gradient, high value spawning habitat for anadromous fish (i.e., refugia) in the North Fork Chetco and in the $5^{th}$-field appears to be more extensive than in some other drainages within the Chetco system (reference Figure 8 - page 38, from Chetco River Watershed Analysis, Iteration 1.0). However, high quality rearing habitats for coho and chinook salmon are lacking.

- *Abundance of fish-bearing streams* - While the presence of numerous *natural* barriers in the analysis area limits the distribution of anadromous fish, those portions of the analysis area inaccessible to anadromous fish provide refuge for resident populations. The abundance of streams bearing both resident and anadromous fish increases the probability that some populations can perpetuate in the case of stochastic events.

***What are the trends in aquatic condition, and what forces have the potential to reduce or limit the viability of key habitats or habitat elements?***

The trend for all stream channel types in the analysis area is likely to be static or improving because: 1) the rate of landsliding and debris torrents observed between 1955 and 1970 has reduced to near-1940 levels, 2) abundant rough substrates (such as bedrock, boulders and cobble), and prevalence of constricted or constrained stream channels prevents much vertical or lateral adjustment in all stream types noted in the analysis area..

Aquatic habitat conditions on BLM lands are fair to good, while others are poor. Guidelines contained within the NWFP and BLM RMP provide protection for all aquatic and riparian habitats on public land through the system of Riparian Reserves and other land designations, including LSRs, ACECs, and Key Watersheds. Private lands, however, will continue to receive more intense pressure from logging and road building in and across riparian areas.

***What are the management objectives for aquatic and riparian habitats in the analysis area?***

*Stream Channel:* Attain a stable channel for all channel types. Stability means that the stream has the ability over time to transport the sediment and flow produced by the analysis area in such a manner that the channel maintains its dimensions, pattern and profile without either aggrading or degrading (Rosgen 1994).

*Connectivity:* Maintain and restore connectivity between and within streams for *all* aquatic species. When deteriorated or poorly designed culverts are replaced, they should be designed to allow *all* species access to historic habitat. Specifically, roads should be closed whenever possible and stream crossing culverts should be removed during road closure. If roads are to remain open, new culverts should be placed in contact with the stream bed and designed to replicate natural stream-bottoms where possible (i.e., to collect gravel throughout).

*Emphasis on Processes*: Restore the processes which create and maintain habitat for aquatic organisms. For example, the input of large wood and boulders onto floodplains and into stream channels via landslides and debris torrents is an integral part of creating and maintaining habitat for riparian and aquatic organisms. In some cases, the input of these materials via landslides and debris torrents is blocked by riparian roads and culverts. The removal (when possible) of riparian roads and/or avoidance of road construction in riparian zones helps restore or maintain inputs of large material. Large wood that has the potential to be delivered to stream channels should remain in the riparian area or be placed in stream for aquatic habitat, rather than removed.

*Protect Refugia:* Portions of the analysis area currently providing good-quality habitat for fishes, invertebrates, amphibians, and other aquatic species should receive priority in protection and restoration. In drainages where resident fish production appears high or where fish are distributed well into the headwaters (Mayfield Creek), and where stream ecosystem connectivity is relatively intact (all BLM lands, but primarily Bravo and Ransom Creeks), management activities should be designed to avoid fragmentation of habitat with barriers which may restrict access to habitat (i.e., roads and culverts).

*Habitat Quality:* "Any species-specific strategy aimed at defining explicit standards for habitat elements would be insufficient for protecting even the target species" (Standards and Guidelines, B-9). Projects to restore or improve habitat quality should focus on restoring conditions appropriate for all aquatic organisms. A specific management objective for habitat quality is twofold: (1) meet or exceed ODFW criteria for "good" fish habitat, and (2) conduct habitat improvement projects which create and maintain a diverse array substrates to support diverse invertebrate and amphibian communities.

*Cooperation*: Opportunities exist for joint habitat-restoration projects with watershed associations, ODFW, and South Coast Lumber Company throughout the analysis area. Management should focus on establishing joint project-goals and sharing implementation and monitoring of subsequent projects.

*Emphasis on Aquatic-Riparian Linkages*: A dynamic linkage between riparian zones, floodplains, and streams is necessary for proper functioning of each element. Management activities should focus on creating and maintaining hydrologic and physical links between riparian and aquatic systems, such as: restoring natural vegetative assemblages including the presence of large conifer along streams, and placement of large wood that links stream channels to floodplains, and provides habitat for riparian and aquatic organisms.

## IV.3 AQUATIC and RIPARIAN SPECIES

***What aquatic and riparian-associated species are currently present, and how are they distributed?***

Table IV-4 lists special status species that are obligate users of streams or riparian areas during their life cycle that are found or are likely found within the analysis area (refer to Section VI-Riparian Reserve Evaluation for additional riparian-associated species). Species are grouped by guild to emphasize functional relationships. Specific information about each species or group with special management status follows the table. Although there have been no known recent extinctions, population sizes and distributions have changed. For example, Oregon Coast coho salmon (Federally Threatened) are now virtually absent from the analysis area.

The North Fork Chetco analysis area contains approximately 14 miles of anadromous and resident fish-bearing streams, and an additional 18 miles containing only resident fish. Fish species include fall chinook salmon, coho salmon, winter steelhead, resident rainbow trout, anadromous and resident cutthroat trout, and Pacific lamprey. For anadromous fish, access to spawning and rearing habitat in the analysis area is thought to be limited by only *natural* barriers or habitat conditions (refer to Section IV.2-Aquatic Habitat).

<u>Amphibians</u>
Stream and Seep Associated Amphibians (Foothill yellow-legged frog, tailed frog, Southern torrent salamander) - Survey efforts for these species are limited to opportunistic observations. No systematic inventories have been conducted. Foothill yellow-legged frogs occur in Ransom Creek, Bravo Creek, and N. Fork Chetco River where habitat appears to be abundant (numerous course substrates, pool habitats). Tailed frogs occur in Ransom and Bravo Creeks. Southern torrent salamanders are known to occur along the North Fork Chetco River, Mayfield Creek, and Jim Ray Creek.

<u>Beaver</u>
There was a notable absence of beaver in the aquatic habitat surveys conducted since 1972. Beaver within the North Fork Chetco analysis area are primarily bank-dwellers. The steep channels, flashy hydrograph, and lack of extensive floodplains and wetlands in this system limit the potential for persistent beaver habitat (i.e., beaver ponds). There has been virtually no trapping of beaver in the North Fork Chetco analysis area for 20 years (ODFW 1997a), so these conditions may also limit beaver abundance.

**Table IV-4 Aquatic and Riparian Species of Ecological Concern in the North Fork Chetco Analysis Area.**

Species listed have either been found in the analysis area or incorporate the analysis area in their home range. [1]Species without specific legal or management status but are of concern due to role in ecosystem function. [2]At risk of extinction according to Nehlson et. al. (1991).

| Species Group/Guild | Common Name | Scientific Name | Habitat Association | Pop'l Trend | Status |
|---|---|---|---|---|---|
| herbivorous | Beaver | *Castor canadensis* | Lotic, riparian | unknown | ecological concern[1] |
| insectivorous | Chinook salmon (fall) | *Oncorhynchus tshawytscha* | Lotic | decreasing | State Sensitive-Critical |
| insectivorous | Coho salmon | *O. kisutch* | Lotic | decreasing | Threatened<br>State Sensitive-Critical<br>At risk of extinction[2] |
| insectivorous/piscivorous | Coastal cutthroat trout | *O. clarki* | Lotic | decreasing | At risk of extinction[2] |
| insectivorous | Winter steelhead | *O. mykiss* | Lotic | decreasing | Proposed T&E<br>At risk of extinction[2] |
| omnivore | Pacific Lamprey | *L. tridentata* | Lotic (channel margins) | decreasing | State Sensitive-Vulnerable |
| insectivorous/piscivorous | Pacific Giant Salamander | *Dicamptodon tenebrosus* | Lotic, lentic, riparian, springs/seeps | unknown | ecological concern[1] |
| insectivorous | Southern Torrent Salamander | *Rhyacotriton variegatus* | Lotic (channel margins), springs/seeps | unknown | State Sensitive-Critical |
| insectivorous | Dunn's Salamander | *Plethodun dunni* | Riparian, springs/seeps | unknown | ecological concern[1] |
| scraper/herbivore (tadpole)<br>insectivorous (adult) | Tailed Frog | *Ascaphus truei* | Tadpole: Lotic<br>Adult: Lotic, riparian | unknown | Bureau Tracking<br>State Sensitive-Vulnerable |

| Species Group/Guild | Common Name | Scientific Name | Habitat Association | Pop’l Trend | Status |
|---|---|---|---|---|---|
| collector-gatherer/omnivore (tadpole) | Red-legged Frog | *Rana aurora* | Tadpole: Lotic (channel margins) lentic, springs/seeps<br>Adult: Lotic, lentic, springs/seeps, riparian | unknown | Bureau Tracking<br>State Sensitive-Vulnerable |
| insectivorous (adult) | Foothills Yellow-legged Frog | *Rana boylei* | Tadpole: Lotic (channel margins)<br>Adult: Lotic (channel margins), riparian | unknown | Former Fed’l Candidate 2<br>Bureau Tracking |
| scraper-herbivore | Beers’s false water penny beetle | *Acneus beeri* | Larvae: Lotic (cobble, rubble)<br>Adult: unknown | unknown | Former Fed’l Candidate 2<br>Bureau Tracking |
| scraper-herbivore | Burnelli’s false water penny beetle | *Acneus burnelli* | Larvae: Lotic (cobble, rubble)<br>Adult: unknown | unknown | Former Fed’l Candidate 2<br>Bureau Tracking |
| insectivorous | Montane bog dragonfly | *Tanypteryx hageni* | Larvae: Lentic, springs,/seeps<br>Adult: riparian | unknown | Bureau Tracking |
| scraper-herbivore | Denning’s Agapaetus caddisfly | *Agapaetus denningi* | Larvae: small springs<br>Adult: riparian | unknown | Bureau Tracking |
| collector-gatherer/ scraper omnivore | Redwood juga | *juga orickensis* | Larvae & Adult: Lotic - small spring-fed permanent rivulets to creeks; clear cold running water | unknown | Riparian Reserve Assessment Species |

Fall Chinook Salmon
The biology and life-history of chinook salmon have been summarized elsewhere (see Groot and Margolis 1995). The fall chinook salmon of the North Fork Chetco River and the Chetco River system are classified as south-migrating (Euchre Creek through Winchuck River basins). ODFW spawning surveys have shown a decline in south-migrating stocks since 1960 (Coony and Jacobs 1997) which is thought to be a result of overexploitation during a time of poor ocean productivity (Coony and Jacobs 1994). Current population sizes in the North Fork Chetco River cannot be accurately measured but total Chetco River populations are estimated to be about 15,000 fish (USFS 1996a).

Adult chinook return to the North Fork from the ocean between mid-October and mid-January. Peak spawning is variable and has been observed from the second week of November through the last week in December. The majority of female spawners in the Chetco River are 4-5 year-old fish, while the majority of male spawners are 2-3 year-old fish (Nicholas and Hankin 1988). After emergence, chinook salmon juveniles are probably present in lower reaches of the North Fork through June, and then in the mainstem Chetco River and estuary through September. See Nicholas and Hankin (1988) for additional life history information on all chinook salmon stocks in Oregon.

Spawning surveys in the North Fork Chetco River have regularly been conducted for chinook salmon since 1989 (Table IV-5) (ODFW 1997b; Jacobs and Coony 1997). Chinook salmon use extends upstream to a boulder canyon barrier at approximately stream mile six. Based on high spawner densities relative to other drainages in the Chetco basin, the lower 1.2 miles of the North Fork Chetco River could be considered a ‘hot-spot’ for spawning chinook salmon.

**Table IV-5 Peak counts on the North Fork Chetco River chinook spawning survey, 1989-1996.**

| Year | Peak Adult Count | Peak Jack Count |
|---|---|---|
| 1989 | 209 | 21 |
| 1990 | 51 | 4 |
| 1991 | 93 | 6 |
| 1992 | 1 | 20 |
| 1993 | 180 | 25 |
| 1994 | 213 | 13 |
| 1995 | 129 | 4 |
| 1996 | 59 | 2 |

The survey begins at the mouth and extends upstream 1.2 miles to an unnamed tributary entering from the east. Area under the curve estimates can not be determined for most years.

Coho Salmon
Southern Oregon/Northern California coho salmon are listed as Threatened under the federal Endangered Species Act. Numbers of coho salmon in the Chetco River are extremely low and there is no distinct self-sustaining population. In previous times, some considered Chetco River coho salmon to be a fair sized run (OSWRB 1963, in USFS 1996a), although the portion of the run

contributed by strays from other basins is unknown (ODFW 1997b). Spawning surveys are not conducted for coho salmon in this region and sightings of fish in the Chetco system during the last decade have been scarce. The presence of juveniles in neighboring Emily Creek in 1993 suggests one or two successful redds. There is little suitable coho salmon rearing habitat anywhere in the Chetco basin, and habitat in the analysis are is likewise limited.

Winter Steelhead

Chetco River steelhead, together with stocks from Cape Blanco to the Klamath River (inclusive), represent an Evolutionarily Significant Unit (ESU) that has been proposed for listing under the federal Endangered Species Act (the Klamath Mountains Province Steelhead). The Chetco River population is considered depressed (Nickelson et al. 1992c) and steelhead within this ESU are likely to become endangered in the foreseeable future (Busby et al. 1994). Average run size (1970-91) size is 5,100 total and 2,600 natural fish (49% hatchery) (Busby et al. 1994). Current population size, carrying capacity, and trends in escapement of adult and juvenile winter steelhead in the analysis area is unknown, but probably parallel that of the rest of the Chetco River population.

Winter steelhead migrate upriver with winter rains, and spawn in winter and early spring. Four months after spawning, juveniles emerge from the gravel and rear 2-3 years in the river before smolting. While in the ocean, few Chetco River fish are observed north of Cape Blanco (Pearcy 1992, in Busby et al. 1994), indicating that these fish are either south-migrating or stay in the vicinity of southern Oregon/northern California. Adults spend 2-4 years in the ocean before returning upriver to spawn. Up to 30% of the adults may survive to spawn a second or third time.

Spawning surveys for steelhead were conducted on the North Fork Chetco River in 1996 (Table IV-6) (ODFW 1997b). Although precise distribution is unknown, in steelhead spawn in North Fork Chetco reaches 1-5, in the first reach in each of Bosley, Bravo and Ransom Creeks, and in the lower sections of several unnamed tributaries to the mainstem (Figure IV-10). Based on high spawner densities relative to other drainages in the Chetco basin, the 1.6 mile survey reach could be considered a ‘hot-spot’ for spawning steelhead.

**Table IV-6 Peak counts on the North Fork Chetco River steelhead spawning surveys, 1996-1997.**

| Year | Peak Steelhead Count | Peak Redd Count |
|---|---|---|
| 1996 | | |
| Upper survey | 22 | 9 |
| Lower survey | 20 | 21 |
| 1997 | | |
| Upper survey | 54 | 16 |
| Lower survey | 34 | 4 |

The lower survey begins at the bridge for the 40-13-5.1 road (sometimes referred to as the 1000 Road) and proceeds upstream 0.8 miles. The upper survey begins at the upstream end of the survey and proceeds upstream another 0.8 miles.

## Resident Fish

Resident and anadromous cutthroat trout and resident rainbow trout are distributed throughout the analysis area. For resident fish, access to habitat is primarily limited by natural barriers (high gradients or cascade/falls). In some streams, numerous passable obstacles cumulatively restrict the upstream distribution of fish. The only known human-caused barrier to fish migration is a culvert on the northern tributary to Mayfield Creek (Sec. 17, NW 1/4, NW 1/16). Although resident cutthroat trout were observed upstream of the culvert, it is a barrier to upstream movement.

Resident rainbow trout in Bravo Creek are the apparent result of residualized steelhead fry releases in 1981-82. Suspected cutthroat/rainbow hybrids have been observed in Bosley Creek (BLM 1997) and Bravo Creek (BLM 1972). Mature male rainbow trout were also observed in the North Fork upstream from 40-13-5.1 road bridge in September, 1983 (ODFW electro fishing survey) indicating the presence of resident rainbow trout throughout North Fork Chetco analysis area.

Surveys conducted in May-June, 1997, point to several unique resident trout populations:

- *Mayfield Creek*- high densities of resident cutthroat trout that persisted upstream of numerous natural barriers and one culvert barrier into the extreme headwaters of the drainage.

- *Bosley Creek*- low densities of resident trout, but apparent cutthroat/rainbow hybrids; fish appeared to contain characteristics of both cutthroat and rainbow trout.

- *Bravo Creek*- resident rainbow trout above a natural boulder canyon, where a 1972 survey reported the absence of fish and recommended fish release. Rainbow were likely residualized steelhead from 1980 and 1981 releases of steelhead fry (ODFW, personal communication 1997a).

- *Unnamed tributary to NF Chetco (T39S-R13W-Sec. 31, 32)*- high density of large cutthroat trout (some $\geq$12 inches).

## Other Fish Species

No data is available from which to assess the population status of other fishes (sculpins, Cyprinids, lamprey) in the analysis area. Anecdotal information suggests that the numbers of spawning resident and sea run cutthroat trout are below historic levels.

***How have management activities and natural processes changed the abundance, distribution, and movements of these species or the character of their habitats?***

<u>Amphibians</u>

Stream and Seep Associated Amphibians (Foothill yellow-legged frog, tailed frog, Southern torrent salamander) - Habitat quality for Foothill yellow-legged frogs appears high (lots of rocks, protected backwater pools areas during summer, moderate gradient). Nussbaum (1983) reported water temperature preference for yellow-legged frogs of 45-70 degrees F. Summer temperature monitoring found 7-day maximum temperatures slightly above 70 degrees on the lower North Fork Chetco River and on Bravo Creek which may limit habitat effectiveness. Torrent salamanders and tailed frogs require cold, clean water (low in silt). Blaustein et al. (1995) cite studies reporting temperature preferences of 46-54 degrees F for torrent salamanders and ≤ 72 degrees F for tailed frogs (< 50 degrees F for first-year tadpoles). In the analysis area, fine sediments are quickly transported out of the system during storms and generally do not accumulate in streams (refer to Section 4.1-Water Quality). Water temperatures, though, exceeded preferred temperatures for tailed frogs and torrent salamanders at each of the 5 temperature monitoring stations in the analysis area suggesting that water temperature may be limiting for these cold-water species. Flooding can decimate populations of larval tailed frogs (cited in Blaustein et al. 1995). The November 1996 flood (a 14 year flood event) could have reduced tailed frog populations in the analysis area.

<u>Beaver</u>

Beaver may be present in the lower portions of the North Fork Chetco river where the lower gradient and wider floodplains make for better habitat. Steep gradients and high, flashy winter flows probably limit habitat quality in the rest of the analysis area.

<u>Salmonids</u>

The effects of specific management practices and channel processes have been described in Section IV.2-Aquatic Habitat. In general, these practices directly affect fish production and survival when they alter the levels or timing of peak and base flows, route sediment into streams, simplify channels, limit habitat complexity, reduce food supply, and increase stream temperatures.

<u>Chinook Salmon</u>

A hatchery supplementation program for chinook began in the Chetco River basin in 1968 (1969 releases). Annual smolt releases averaged 371,000 between 1981 and 1994. Releases have since been reduced to 230,000 smolts from wild broodstock. No chinook smolts have been released into the North Fork, but there were several fry and/or presmolt releases in the North Fork between 1981 and 1992. Fry and presmolt releases were discontinued in the Chetco after 1993. Based on scale analysis, a large proportion (up to 50%) of the spawning population in the North Fork Chetco is composed of hatchery fish. This is probably due to the large hatchery program in the Chetco River and the lower river release sites used for smolts. The North Fork Chetco, along with neighboring Jacks and Big Emily Creeks, produces a high proportion of the chinook spawners for the basin, primarily because these drainages are situated lower in the basin, in closer proximity to the lower river release sites [hatchery and population information provided by ODFW, Gold Beach OR].

The following was excerpted from the Chetco River Watershed Analysis (USFS 1996a): “Since they [chinook] spawn in early winter in low gradient, gravel rich channels, their nests are very sensitive to mid- and late-winter storm damage. Redd success is suspected to be very low for mainstem spawners in all but the very mildest winters. Another critical in-river habitat consideration is warm lower-river peak water temperatures, which could negatively affect juveniles concentrated in the lower river prior to entering the ocean."

<u>Coho Salmon</u>
In the freshwater environment, the effects of management activities on salmonids may not be equal across all species. Resident trout and coho salmon may be particularly susceptible to limiting factors in the freshwater environment because they spend a greater portion of their life-cycle in freshwater than do chinook. Based on the relatively low survival rates from coho fry to smolt when compared to chinook (Sandercock 1991), it is apparent that the freshwater environment plays a major role in the fluctuation of coho abundance. In the North Fork Chetco analysis area, management activities over the last century have differentially affected habitat required by coho salmon for life-stages where highest mortality rates are typically observed. For example, survival during the critical period immediately after emergence is dependent on the availability of low velocity areas and the ability of coho fry to establish territories within them (Sandercock 1995). However, loss of large wood by harvest and salvage may have reduced channel-margin habitat and complex pools which provide refuge for fry. Elimination of these winter rearing habitat is proposed as a major factor limiting coho production in coastal streams (Nickelsen et al. 1992a).

<u>Steelhead</u>
A hatchery supplementation program for steelhead began in the Chetco River in 1969 (ODFW 1997b). Alsea stock was used through 1976; since 1977, Chetco stock have been used. The current supplementation program releases 50,000 smolts/year. There were some fry/presmolt releases between 1982 and 1991, but ODFW discontinued releases of steelhead fry in the Chetco River to avoid competition between hatchery and wild fish. No steelhead smolts have been released into the North Fork; however, fry were released at several locations along the North Fork (16,000 in 1981; 240,000-242,000 in 1985 and 1986), and in Bravo Creek, probably at the stream crossing on Road 40-13-2.0 (29,000 in 1980; and 21,000 in 1981).

<u>Cutthroat Trout</u>
Observations of resident rainbow trout and apparent cutthroat/rainbow hybrids indicate that hatchery supplementation with steelhead fry/presmolts may have had an impact on the genetic composition of resident cutthroat trout populations throughout the analysis area. Further information regarding releases between 1969 and 1977 and a genetic analysis of the current resident trout populations are necessary before the full impact of hatchery releases in the North Fork Chetco can be assessed.

<u>Other Fish Species</u>
Information has not been collected on non-salmonid species in the analysis area and it is therefore difficult to identify population trends and the major factors affecting abundance and survival. It is likely that species such as lamprey, sculpin and the Cyprinids in the analysis area have been particularly affected by management activities since these species occupy freshwater throughout most or all of their lifetimes.

<u>Trends</u>
Implementation of the Aquatic Conservation Strategy of the Northwest Forest Plan should improve habitat conditions for most aquatic and riparian-associated species on federal land. Because the

State Forest Practices Act provides limited protection during private timber harvest and road building activities, aquatic and riparian habitats will likely continue to fragment and degrade in portions of the analysis area. Protection of aquatic and riparian habitats on public lands and restoration initiatives on both public and private lands could assist in the recovery of anadromous and resident fish stocks, if ocean conditions and fish harvest management are concurrently favorable.

***What are the management objectives for aquatic and riparian species in the analysis area?***

Fish

The objective of management should focus on providing habitat conditions for self-sustaining populations of native anadromous and resident species.

For chinook salmon, which spend only a short time in fresh water, it is extremely difficult to conduct meaningful assessments of population sizes and trends at the watershed scale based on numbers of returning adults (spawning) because inter-annual and between-population variation are typically great (Healey et. al. 1984). Management objectives should therefore focus on *establishing and measuring* conditions known to maximize chinook production and survival (abundant, clean gravel/cobble beds for spawning and incubation, presence of marginal areas and complex pools for rearing) and *preventing or minimizing* conditions known to cause widespread mortality of eggs, alevin, and fry (instability of gravel beds, lack of velocity checks, sedimentation, high stream temperatures, etc.).

For coho salmon and steelhead trout, which may spend several years in the North Fork Chetco system, freshwater rearing conditions may play a dominant role in regulating abundance and survival. Management objectives should therefore focus on *establishing* and *measuring* freshwater rearing conditions known to maximize production and survival of these fishes (abundant, clean gravel beds for spawning and incubation, presence of low-velocity, complex in-channel and off-channel pools, good water quality and sufficient food supply) and *preventing* or *minimizing* conditions known to reduce survival and abundance (instability of gravel beds, sedimentation, low abundance of suitable rearing pools, high stream temperatures, etc.). Attainment of this objective means reaching minimum summer seeding (rearing) levels of approximately 1 coho parr/m$^2$ /pool (Nickelson et al. 1992).

Cutthroat trout spend their entire life-history in the analysis area. Specific habitat objectives for chinook and coho salmon and steelhead trout should benefit cutthroat trout as well. In particular, activities which increase habitat complexity will subsequently reduce interspecific competition between cutthroat trout and the dominant competitor, coho salmon. In addition, management should focus on maintaining connectivity to historic small-stream habitat and refugia for native trout (through the removal of barrier culverts and protection of small streams). Finally, introduction or release of steelhead above historic, natural barriers in the analysis area should be discouraged to protect resident trout populations above.

Little is known about the habitat requirements of other fish species in the analysis area, such as the sculpin, Cyprinids, and Lamprey. In general, management actions which maintain or improve water quality and increase habitat complexity and food abundance should benefit these species as well.

Other Species
Maintain populations of aquatic and riparian species and improve connectivity between populations. Discourage introduction of non-native species. See also Management Objectives for Terrestrial Habitats (Section V.2).

## IV.4 RIPARIAN HABITAT

***Where is the boundary of the riparian plant community, and what factors determine this boundary?***

Riparian ecosystems are associated with streams and rivers, from intermittent headwater streams with no floodplains, to mainstem river reaches. These riparian ecosystems include floodplain and streambank plant and animal communities affected by the stream through water supply, flooding, or lateral transport of nutrients and sediments. The riparian ecosystem may also be defined as the area (with its associated processes) that directly affects the stream, including it's effect on shade and microclimate. Riparian forests also have profound effects on stream ecology, through the supply of sediment, leaf litter, and course and fine woody material. Therefore, depending on the function of interest, riparian zone boundaries can extend from 25 to >150 feet from streams in the analysis area.

Riparian vegetation boundaries in unharvested areas are often marked by the presence of mature and old-growth conifer trees which have survived repeated fires. This boundary (each side of the stream) ranges from less than 50 feet along small first- and second-order streams, to 150 feet along larger streams. Nearly 100% of the large wood recruited to streams from these areas is within 100 feet of the stream channel. Along lower gradient reaches (North Fork Chetco, reach 1), the riparian area extends to the edge of the floodplain, often greater than 150 feet from the bank-full channel. On many small headwater streams, including intermittent channels, seeps, and springs, the riparian area is often marked by dense mats of salal extending as few as 25 feet from the stream edge.

***What are the riparian plant communities (plant associations) in the analysis area?***

Riparian areas in the analysis area are composed of several plant associations, some of which are described in the *Field Guide to Plant Associations of Southwestern Oregon* (USDA Forest Service, 1996b). This publication includes a taxonomic system developed by researchers who compared numerous plant communities in the Siskiyou Mountains. The key organizes sites according to their potential natural vegetation if left undisturbed by fire, insects, etc. The system is based on the presence, absence, and abundance of plant species, as well as abiotic factors such as elevation and moisture. It is useful for communication among professionals, and for developing appropriate management guidelines. The following analysis was based on a riparian vegetation inventory (BLM, 1995) conducted within 100 feet of major streams, including the North Fork Chetco mainstem, Jim Ray Creek, and Ransom Creek.

The primary overstory species in unlogged riparian areas is Douglas-fir (range 5-50% cover; mean

15-20%). Western hemlock, western redcedar, and Port-Orford-cedar are absent along the larger streams, but are present in a few locations on the western edge of the analysis area. The reason for this is unknown, but it may influenced by repeated fires, lack of a proximal seed source, and the fact that the analysis area is near the southern end of the range for some of these species. Bigleaf maple, tanoak, and Oregon myrtle (California laurel) co-dominate the middle and understory of unlogged riparian areas (5-25% cover each). Red alder is generally found in a narrow band immediately adjacent to streams and on disturbed (logging, flooding or landslide) sites (5-30% cover). Previously harvested areas in main-stem reaches contain a mix of hardwoods in the overstory (red alder, bigleaf maple, tanoak, and Oregon myrtle), with no large conifers. Indicator shrubs and herbs in inventoried reaches include evergreen huckleberry (5-30% cover) and sword fern (25-50% cover). California hazel, oxalis, salal, rhododendron, and Oregon grape are also present, the latter three dominating the shrub layer in some seeps, springs, and perennial and intermittent first-order streams. In general, cover of salal and tanoak tends to increase as soil moisture decreases toward the headwaters.

The inventoried riparian plant communities correspond most closely plant associations of the tanoak series, generally in areas with higher mean annual precipitation and higher mean annual temperatures (page LIDE3-1 to 3-3 of USDA Forest Service, 1996b). Along larger streams, vegetation is best characterized by:

- LIDE3/PSME/GASH-VAOV2 (page LIDE3-34) TANOAK-DOUGLAS-FIR-EVERGREEN HUCKLEBERRY

The following may also apply:

- LIDE3/VAOV2-RHMA3-GASH (page LIDE3-36) TANOAK/EVERGREEN HUCKLEBERRY-PACIFIC RHODODENDRON-SALAL
- LIDE3/TSHE/VAOV2-RHD16 (page LIDE3-38) TANOAK-WESTERN HEMLOCK/EVERGREEN HUCKLEBERRY-POISON OAK
- LIDE3/TSHE/VAOV2/POMU (page LIDE3-40) TANOAK-WESTERN HEMLOCK/EVERGREEN HUCKLEBERRY/WESTERN SWORDFERN
- LIDE3/TSHE/VAOV2/POMU-RIP (page LIDE3-42) TANOAK-WESTERN HEMLOCK/EVERGREEN HUCKLEBERRY/WESTERN SWORDFERN *(Rip)*

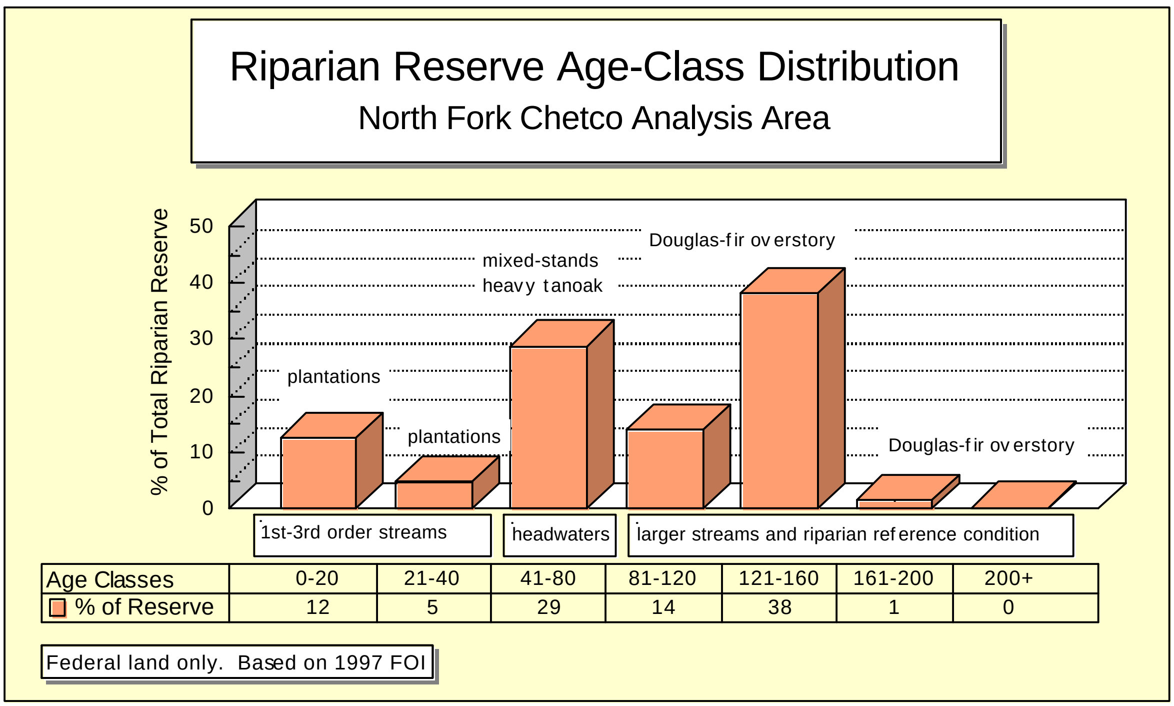
On smaller streams (perennial or intermittent), vegetation is often characterized by:

- LIDE3-PSME/GASH-RHMA3 (page LIDE3-30) TANOAK-DOUGLAS-FIR/SALAL-PACIFIC RHODODENDRON

### *What are the age-class distributions and seral stages of riparian vegetation?*

On BLM lands, age class (FOI data) within Riparian Reserves can be used to approximate seral stage (Figure IV-11); this information is not available for private lands. FOI data is less accurate for the older age-classes (>80 years), because it classified some stands containing residual mature and old-growth Douglas-fir trees by the condition of the understory (i.e., dense tanoak stand). In addition, some riparian areas known to contain Douglas-fir 200-500 years old are not represented at all in FOI (e.g., Bravo Creek, Mayfield Creek). Therefore, some stands classified in Figure IV-11 as within the 41-160 year-old age-classes should actually be in the 161-200+ age-classes. No estimate of this acreage has been made, but it probably would not exceed 10% of the Riparian Reserves. Stands in the 41-80 year age-class are primarily located in areas that burned intensively in 1938, such as the headwaters of Bravo Creek and areas near Bosley Butte. They contain mostly tanoak, but some have remnant Douglas-fir.

**Figure IV-11 Riparian Reserve age class distribution within the North Fork Chetco analysis area.**




| Age Classes | 0-20 | 21-40 | 41-80 | 81-120 | 121-160 | 161-200 | 200+ |
|---|---|---|---|---|---|---|---|
| % of Reserve | 12 | 5 | 29 | 14 | 38 | 1 | 0 |

.

Another analysis of seral stage distribution, based on a query of FOI for specific vegetation features, is shown in Figure V-4 (Section V.2-Terrestrial Habitat). No age-class information was compiled for private lands, although the riparian inventory indicated that many main-stem reaches are composed of a mix of mature hardwood species, with no large conifer in the overstory.

***How do abiotic physical attributes of land affect the development and maintenance of riparian vegetation (slope, aspect, soil fertility)?***

The North Fork Chetco area is characterized by convex side-slopes. This contrasts with concave side-slopes in basins to the north such as the Coquille River. Slope gradient is low to moderate near ridge tops (stable slopes) and high adjacent to stream channels (unstable slopes) (Figure III-3). This condition leads to frequent stream-side slides (as opposed to up-slope slides) The influence of these processes on vegetation is discussed under the following analysis question.

Southern and western-facing slopes receive more direct solar radiation and tend to be hotter, drier and more prone to fire. In the analysis area, these conditions would favor growth of xeric plant species such as rhododendron, salal, Oregon grape, poison oak, and tanoak. North aspect slopes generally receive heavy orthographic shading and retain more moisture during summer. These conditions would favor growth of mesic plant species such as red alder, bigleaf maple, Oregon myrtle (California laurel), salmonberry, vine maple, and oxalis.

Soil fertility and site productivity in riparian areas is generally higher than upslope due to increased moisture, deposition of organic material on floodplains, deeper colluvial soil, and nutrient exchange through groundwater.

Streams in the analysis area are generally topographically protected from wind, and in some areas, solar radiation. However, mature stream-side conifers within narrow buffers are susceptible to minor wind-throw (personal observation).

***What are the prominent natural and human disturbance processes (e.g., fire, floods, landslides, logging), and how do they influence the pattern of riparian plant communities over the landscape through time (disturbance, succession)?***

The primary natural disturbance processes affecting unlogged forests of the North Fork Chetco analysis area are wildfire, landslides, and floods. Human disturbances include logging, road construction, and human-set fires.

Regional patterns of disturbance by fire can be classified into three major time periods, but it is unclear as to what extent the analysis area was affected:

| | |
|---|---|
| *Prehistoric-* | frequent low-intensity fires set by Indians and lightening, with relatively few large, hot fires. |
| *Historic-* | many large, hot fires set by miners and ranchers around the turn of the century |
| *Recent-* | effective fire suppression beginning in the 1940's. |

Frequent fires in unlogged riparian areas are evidenced by scattered fire scars on live trees, charcoal in the soil, and the mosaic pattern of vegetation. Prior to fire suppression beginning in the 1940's, early Euro-American settlers set high-intensity fires which frequently spread from ridge to ridge, burning across large areas. Concurrently, low-intensity fires crept downslope, into and through riparian areas, without affecting the overstory riparian canopy. As a result, unharvested riparian areas adjacent to many small first- and second-order streams, as well as mainstem reaches, contain relatively high densities of large conifer trees compared to many upslope areas in the analysis area. These trees are available for snag and down log recruitment. Low-intensity fires in riparian areas generally set back the seral stage of understory shrub and hardwood trees such as tanoak, Pacific madrone, Oregon myrtle (California laurel) and big leaf maple, and leave the larger, more fire-resistant Douglas-fir. After low-intensity fires, these mid- story hardwood trees are not usually killed. Excepting alder, they sprout prolifically from their stumps, suppress conifer establishment, and reoccupy and dominate the middle and understory at these sites.

Shallow-rapid stream-side landslides occur naturally, and contribute to the mosaic of riparian vegetation. However, management activities (road construction and logging) account for an increase in landslide rate by three time the natural rate for this analysis area (refer to Section III.5 - Erosion Processes, for further discussion on landslide rates). Spatially and temporally dispersed stream-side slides were evidenced by numerous concave riparian slopes (slide tracks) with trees of varying ages established on them, or no trees at all in the case of very recent slope failures. The loss of the organic layer and top soil to landslides sets back plant succession and favors pioneer species. In reference reaches along Ransom Creek (reach 1, Figure IV-10) and the mainstem North Fork Chetco River (reach 3, Figure IV-10), landslides are colonized concurrently by both red alder and Douglas-fir. These species often successfully regenerate on stream-side slides, due to their ability to out-compete other vegetation on bare soils, and the reduction in competition from tanoak, which is often removed when landslides occur.

Flooding and high water tables favor establishment of a wide assortment of hardwood species. Red alder dominate within 25 feet of hillslope-constrained and high-gradient channels. Streams with more extensive floodplains, such as those in reach 1 of the mainstem North Fork Chetco (Figure IV-10), have a wider band of hardwood vegetation dominated by red alder and Oregon myrtle, but also contain bigleaf maple, Oregon ash, willow, cottonwood, elderberry, cascara, and salmonberry, among others.

Clearcut logging (often by tractor), road construction, and post-fire salvage of conifers, has set back the seral stage and altered the species composition of riparian vegetation on almost all private lands in the analysis area. Logging has resulted in the near-absence of mature Douglas-fir, higher abundances of red alder, and greater cover of sword fern (>70%) within 100 feet of North Fork Chetco River, reaches 1, 2 and 4 (Figure IV-10). In some instances, conifer are present in the understory of red alder; in other cases, well-stocked conifer plantations are within 100 feet of the stream. On BLM lands, riparian vegetation along most third- and higher-order streams has not been logged.

Logging, followed by the 1964 flood, resulted in frequent channelized debris torrents throughout the analysis area. The rate of debris torrents peaked in 1970, at 25% of the total number of landslides observed on the aerial photos (Section III.5-Erosion Processes). In torrented channels, stream-side riparian vegetation was removed, and sediment and logs were deposited on wider floodplains, and on flats upstream of channel constrictions. Most of these exposed areas have since revegetated with red alder and other hardwood species.

***What riparian forest stands and stream channels represent reference condition?***

Reference riparian areas contain the highest quantities of live mature and old-growth Douglas-fir trees which are available for snag and down log recruitment. Reference condition in riparian areas is indicated by frequent understory burns that leave mature Douglas-fir in the overstory. and a mosaic of various seral stages and hardwood communities in the middle story and understory. Hardwood species include tanoak, Oregon myrtle, bigleaf maple, and red alder. The abundance of *large* middle story hardwood trees in these areas may have resulted from the modern suppression of fires. The fire pattern is superimposed by a mosaic of stream-side slides colonized by red alder and Douglas-fir of various ages. More frequent and intense burns in some smaller headwater streams have resulted in early-seral communities (overstory and understory) that resemble up-slope areas (i.e., predominance of tanoak).

Riparian reference condition is prevalent in this analysis area, and is best approximated by BLM lands listed in Table IV-7, as referenced in Figure IV-10.

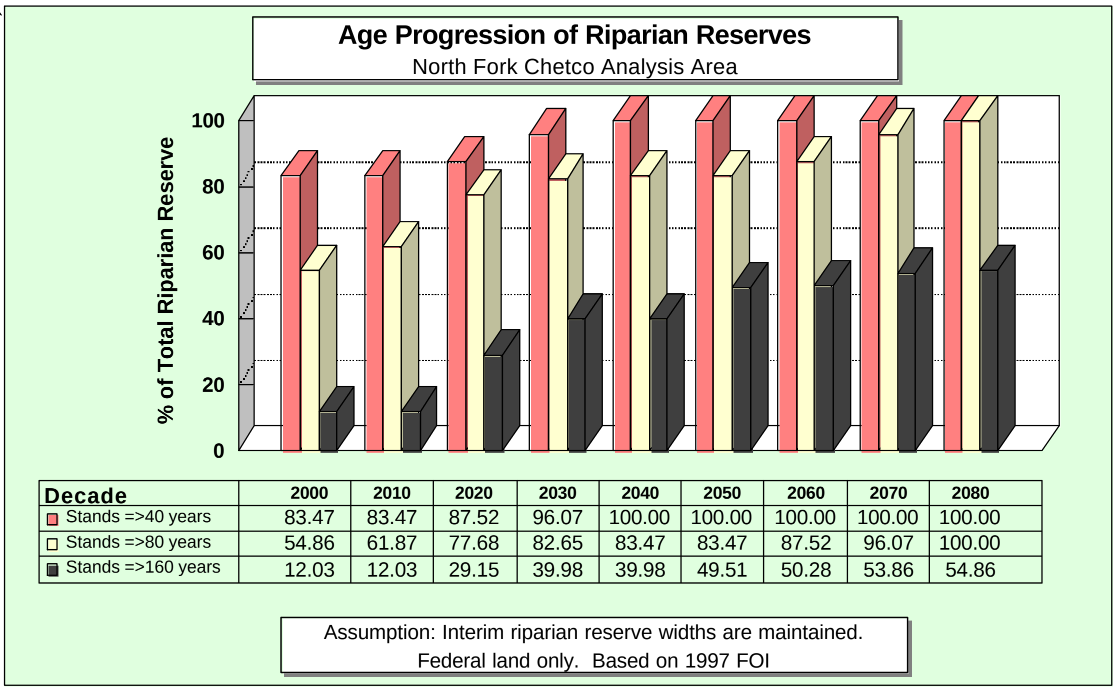
**Table IV-7 Riparian reference conditions in the North Fork Chetco analysis area.**

| Stream Name | Location | Land Designation |
|---|---|---|
| NF Chetco River | Reach 3 | ACEC; LSR; Key Watershed |
| NF Chetco River | 1,000 foot reach of stream in reach 5 | Matrix; Key Watershed |
| NF Chetco tributaries | T39S.-R13W-Sec. 31& 32<br>T40S-R13W-Sec. 6 | Matrix; Key Watershed |
| Ransom Creek and tributaries | Reaches 1 & 2, and tributaries | LSR; Key Watershed |
| Bravo Creek and tributaries | BLM lands in reaches 5 & 6, and tributaries | Matrix; Key Watershed |
| Jim Ray Creek | BLM lands in lower part of reach 1 | ACEC; LSR; Key Watershed, Matrix |
| Mayfield Creek | Isolated areas in headwaters, especially stands in the middle Mayfield Creek tributary in section 17 | Matrix |

***What are the trends of the prevalent riparian plant communities and seral stages in the analysis area?***

On BLM lands in the analysis area, a general stand-age progression of Riparian Reserves can be studied from Figure IV-12. Currently 55% of the Riparian Reserve system is in a mid- to late-seral condition, and within 30 years, 80% will reach that level. However, most of the 41-80 year-old age-class (i.e., the age-class that will move into mid- to late-seral within 30 years) contains tanoak-dominated stands. While some of these stands may contain suppressed or intermediate Douglas-fir, others may not contain a conifer component needed to supply future large wood and snags to the riparian ecosystem. Management techniques (i.e., silviculture or fire) could be used to initiate or accelerate conifer development, but further investigation into management options for these areas is needed.

**Figure IV-12 Age progression of Riparian Reserves in the North Fork Chetco analysis area, based on 1997 Forest operations Inventory Data**. Analysis assumes Interim Riparian Reserve widths are maintained.




| Decade | 2000 | 2010 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2080 |
|---|---|---|---|---|---|---|---|---|---|
| Stands =>40 years | 83.47 | 83.47 | 87.52 | 96.07 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| Stands =>80 years | 54.86 | 61.87 | 77.68 | 82.65 | 83.47 | 83.47 | 87.52 | 96.07 | 100.00 |
| Stands =>160 years | 12.03 | 12.03 | 29.15 | 39.98 | 39.98 | 49.51 | 50.28 | 53.86 | 54.86 |

In unlogged, reference riparian stands (Table IV-7), the absence of low-intensity fires burning through the understory will result in a trend toward more large and decadent hardwood trees in the middle story and a diminished shrub layer. If fire were to reach this hardwood canopy, there could be a greater risk of conducting fire to the overstory Douglas-fir, resulting in a stand-replacement fire.

Young conifer plantations in Riparian Reserves (0-20 and 21-40 age-classes) are expected to retain relatively high densities of conifer as they age, but still contain a hardwood component.. On private lands, intensive management will result in a predominance of early- and mid-seral riparian areas (<80 years old) and young conifer plantations.

***What are the influences and relationships between riparian vegetation and other ecosystem processes (e.g., large wood, channel stability, wildlife species, etc.)?***

Large wood is supplied to stream channels by wind-throw of stream-side conifer trees, landslides, and bank erosion. While large wood effects localized scour and deposition, and serves as a substrate for macroinvertebrates (which in turn provide high quality food for fish and other aquatic species), channel stability in the analysis area is more controlled by bedrock and boulders than by large wood. The relatively low natural recruitment potential and high natural transport potential (due to channel geomorphology and hydrology), combined with effects of harvest and salvage, result in a low abundance and complexity of large woody structure available for aquatic habitat.

Harvest and salvage of riparian vegetation and down wood has resulted in reduced structural complexity in riparian zones throughout the analysis area. In addition to reducing the *amount* of wood inputs, management activities have changed the *nature* of inputs, especially on private lands. For example, down wood recruited to streams is now predominately hardwoods (which tend to be smaller and have a much shorter life span in the stream than do conifers). The predominance of hardwoods and brushy species in riparian zones previously dominated by conifers alters the nature and amount of nutrient inputs. Deciduous shrubs and trees typically contribute greater amounts of organic litter to streams than do conifers, and deciduous litter is often the preferred food source of aquatic shredders (Anderson and Sedell 1979). However, the beneficial effects of increased nutrient inputs from a hardwood-dominated riparian zone will not be realized if insufficient instream structure (caused by lack of large wood in the channel) prevents retention of these added nutrients.

Because fires burn less frequently and intensely in riparian areas, old-growth Douglas-fir forests and large snag/down log habitats are more common in riparian areas (on BLM land). In the analysis area, these habitats often occur as narrow strands through upland areas that are otherwise dominated by hardwoods and earlier seral stages. These corridors of late-successional habitat provide corridors for wildlife movements, as well as provide refugia for repopulating upland areas as they progress into mid- and late-successional stages. They also provide large snag and down log habitats adjacent to streams which are used by many wildlife species. However, these corridors are fragmented by long reaches of much younger riparian stands which lack large conifer trees, logs and snags. Fragmentation and disruption of riparian vegetation reduces its utility for migration and dispersal of fish and wildlife. (refer to Section V-Terrestrial Ecosystems, for additional discussion.)

***Is there adequate riparian canopy closure to maintain desirable stream temperatures for aquatic organisms?***

Depending on stream aspect, channel width, and degree of valley wall confinement, direct solar radiation along some smaller streams can be effectively blocked by hardwood vegetation or topographic shading. Since 1970, hardwood vegetation (and shade) has re-established on debris torrent tracks and on channels exposed following harvest and flooding between 1950 and 1970. Along wider streams, such as the mainstem North Fork Chetco River and Bravo Creek, tall conifer trees are often also required to provide adequate stream shade to maintain the natural range of stream temperatures. Lack of riparian canopy closure may be impacting stream temperature on lower Bravo Creek, lower mainstem North Fork Chetco, and portions of Mayfield Creek. All BLM lands along major streams and tributaries, and private lands on Bosley Creek, generally provide adequate shade to maintain stream temperature. On BLM lands, shade is lacking on first and second-order streams within timber sale units harvested since 1985. Adequate information is lacking for Cassidy Creek, upper NF Chetco, and Mayfield Creek. (Refer to discussion of stream temperature in Section IV.1-Water Quality.)

***Is there adequate potential for recruitment of down wood to streams and riparian areas?***

Most BLM-administered lands (i.e., reference reaches) contain an adequate source of large conifer trees that can be recruited to stream channels, while most private lands do not. Because private lands will likely continue to be managed intensively for forest products, large wood recruitment is likely to remain low.

***What are the management objectives (desired conditions) for riparian vegetation in the analysis area?***

The management objective for riparian vegetation is fourfold:

- Re-establish historic vegetation assemblages and connectivity to the extent possible throughout the analysis area. Riparian areas adjacent to mainstem channels would have a mixed hardwood/conifer overstory, or a overstory dominated by mature and older conifers with a mix of native hardwoods in the middle and understory. Red alder would be present within a narrow band in the zone of hydrologic interaction between the stream channel and riparian area, and present with young conifers on landslide-disturbed sites. The species composition and cover of understory shrubs and forbes would vary with site conditions.

- Re-establish natural/historic fire interval including the presence of low-intensity understory burns in riparian areas.

- Re-establish shade to maintain and recover water temperatures along the mainstem North Fork Chetco River and Bravo Creek.